SIXTH ANNUAL ENGINEERING & DEVELOPMENT ISSUE

October 21, 1957

Including
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materials and equipment

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Build with the wilcox CANARI system

COMMUNICATING AND NAVIGATION AIRBORNE RADIO INSTRUMENTATION

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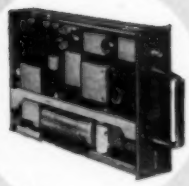
All are Compatible with Your Existing Equipment . . .

MODEL 700 ILS GLIDESLOPE RECEIVER

Small in size and weight, but big in reliability. Receives 90/150 CPS tone modulated signals for ILS glidepath navigation. Room for all 20 UHF frequencies—329.3 thru 335 mc navigation band. Rugged construction... easy to maintain. Choice of three power supplies.

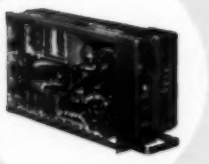


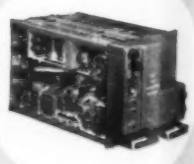
MODEL 705 VHF COMMUNICATIONS RECEIVER

The ultimate in rapid, accurate ground-to-air communications. Brings in CAA Towers, Communications Stations and ATC Centers. Provides 560 channels (every 50 kc channel from 108.00 thru 135.95 mc). Monitors omni-weather broadcasts and CAA voice.

MODEL 706 NAVIGATION RECEIVER

Used for ILS Localizer, VOR Signals and all communications channels (receiver same as in Model 705). Greater range of reception and presentation —ILS Localizer, Manual VOR, Full Automatic Instrumentation and Voice on Localizer and VOR.



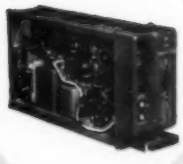


MODEL 701 ADF RECEIVER

Weighs only 21 lbs. yet covers 90 to 1750 kc frequencies in four bands. Automatic bearing information visually presented. Aural reception of modulated RF with either loop or non-directional sense antenna. Higher signal-to-noise ratio.

MODEL 702 MARKER BEACON RECEIVER

Heaviest version weighs only 7 lbs. Provides positive indication of passage over 75 mc markers . . . presented aurally and visually with 3-light system. Responds to ILS and airway markers. Choice of three power supplies.



MODEL 707 VHF TRANSMITTER

Powerful 25 watt minimum power. Cleared call with low noise and distortion level with special engineered audio for speech frequencies. 100% modulation for full voice power. 30 factory Installed channels with 50 kc spacing between 118.00 and 135.95 mc

Perfect companion for type 705 receiver

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The 707-320, Boeing's long-range intercontinental jet, packs some of its big reach in center-wing tanks — also built by Goodyear.

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Fuel Cell Engineering By

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Where Research And Development *Work* To Advance America's Global Position In The Race For Air Power

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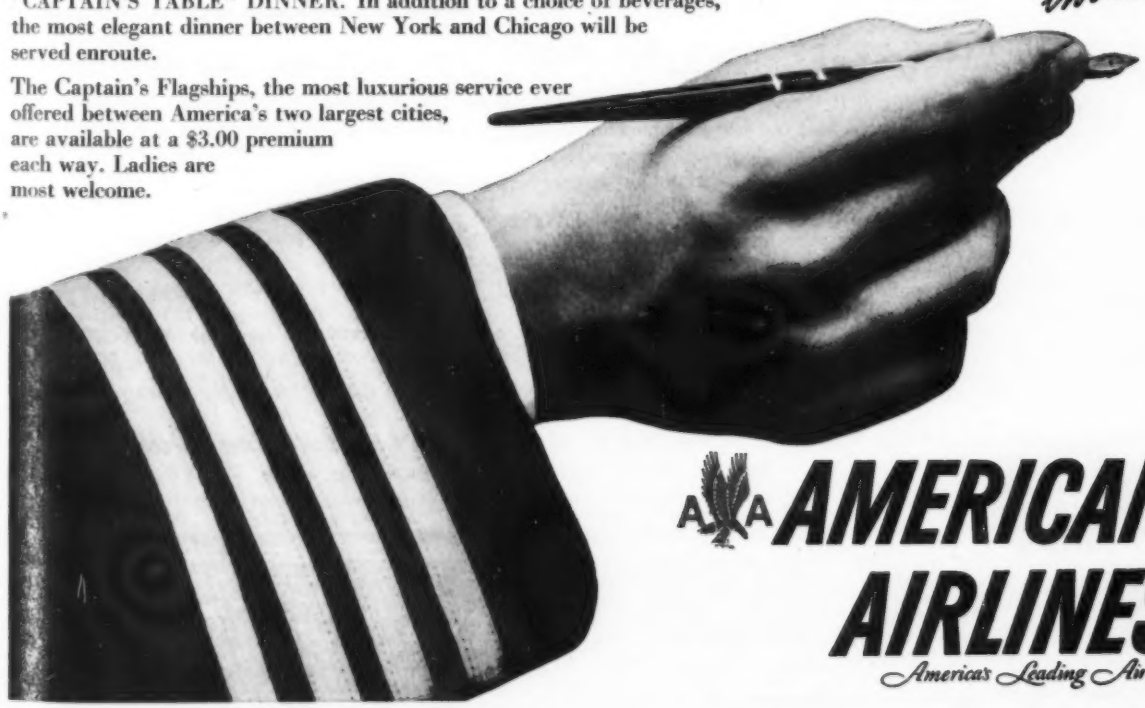
Ladies invited



AMERICAN AIRLINES
America's Leading Airline

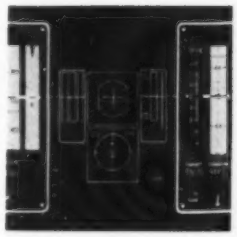
OCTOBER 21, 1957—VOL. 21, NO. 11

AMERICAN AVIATION

WORLD'S LARGEST AVIATION PUBLISHERS

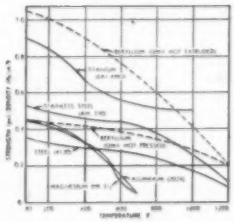
An interview with Erle Martin

Hamilton Standard's general manager tells how company shifted from props to broad product line following World War II and how it successfully handled the transition during the first 10 years. See page 39.



Flight panel of the future

New look in cockpit instruments is typified by system developed by Eclipse-Pioneer for USAF. For details on this and other new instrument developments, see pages 61-65.



Roundup of promising new materials

Quartz, beryllium and columbium head the list in scientists' search for new structures for supersonic flight. Read Wm. Beller's analysis of progress to date, pages 101-104.

What's new in noise suppression

First details of NACA experiments with special exhaust shapes to cut decibel output of jets. Also, some design details on Mach 4 turbojets unveiled during triennial inspection of Lewis Flight Propulsion Laboratory. See pages 116-117.

Contents

Sixth Annual
Engineering & Development Issue
Including
Engineer's Handbook of New Products, Materials & Equipment

EDITORIAL FEATURES

ENGINEER'S HANDBOOK

DEPARTMENTS

64,700 Copies of This Issue Printed.

In this issue . . . AMERICAN AVIATION launches its first Engineer's Handbook of new products, materials and equipment including tables of top new developments during the past 12 months. Also featured are photos, product source listings and a directory of more than 400 manufacturers. A valuable edition for daily desk-top reference throughout the year.

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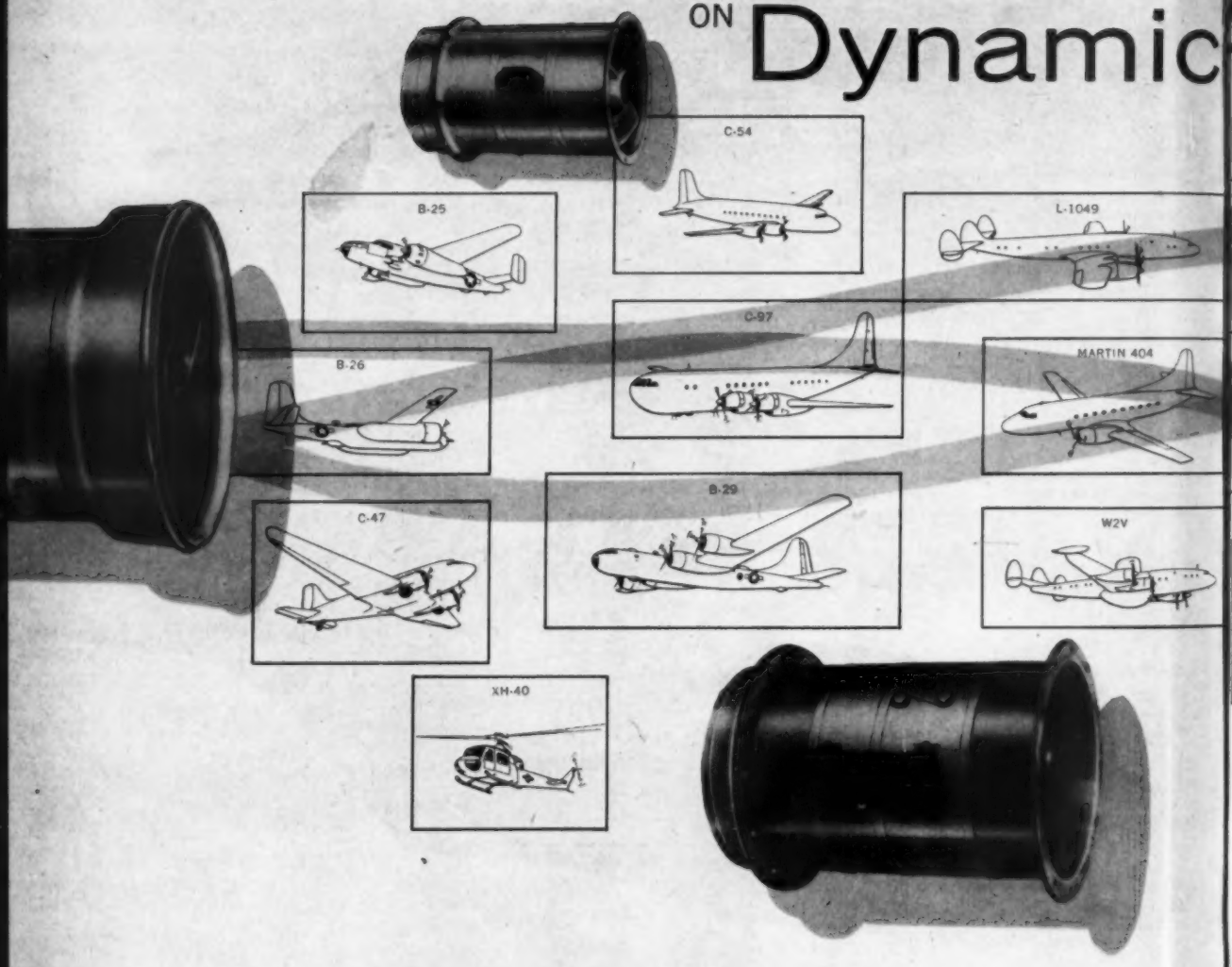
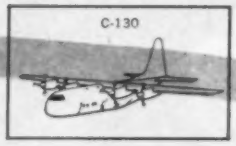
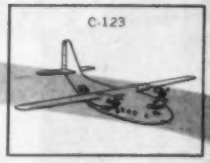
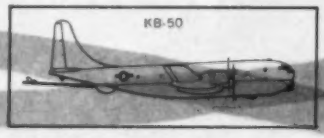
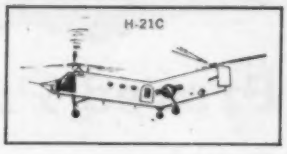


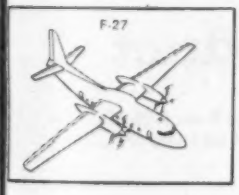
cAir Blowers











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The Type 210 360 Channel VHF Transceiver. Now available—a high powered VHF Transceiver that permits two-way communication on ALL frequencies likely to be used for many years . . . choice of *any* required frequency for any part of the country, whether you fly under VFR or IFR conditions. Here is extra safety insurance for you and others on today's more crowded airways.

THE SYSTEM:

- **Frequency range: 118.00 to 135.95 mc**
- **360 channels, spaced 50 kc**
- **Weight of entire system: 22 pounds, compact size**
- **Operation: single channel simplex or double channel simplex by pilot selection**

TRANSMITTER:

- **Power output: 15 watts, high level amplitude modulation**
- **SCS/DCS: Transmitter can operate 6 mc higher than receiver in DCS position and on same frequency in SCS control position**

RECEIVER:

- **Sensitivity 2 microvolts at 10 db $\frac{S+N}{N}$**
- **AVC: 3 db, 10 to 10,000 microvolts**
- **Image rejection: over 70 db; all other spurious rejections over 80 db**
- **Automatic noise limiter**

Backed by 29 years of leadership in airborne electronic equipment exclusively, and over 18 months of laboratory and flight testing, the Type 210 assures you of ARC's well known exacting standards of engineering and quality manufacture.

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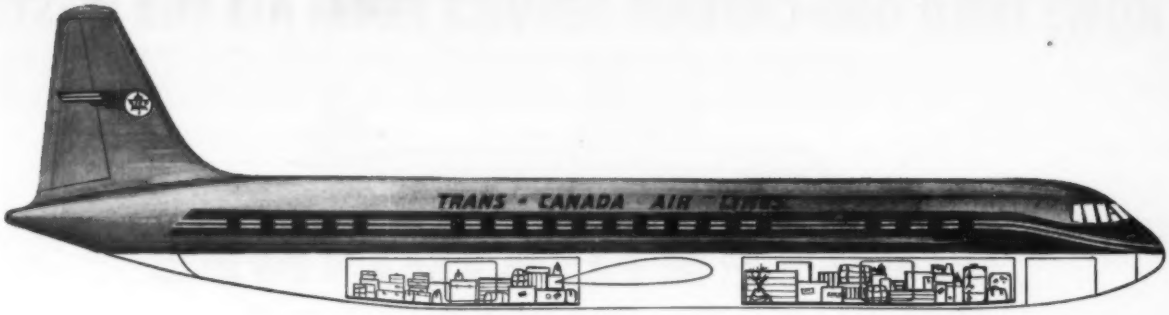
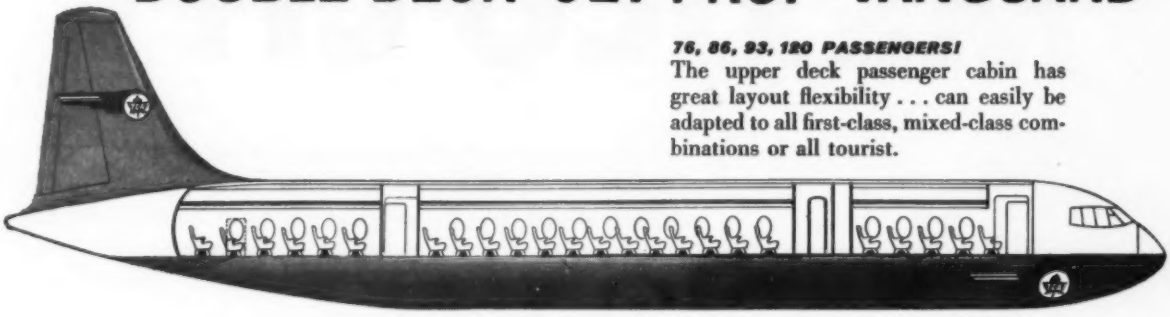


2-in-1 aircraft

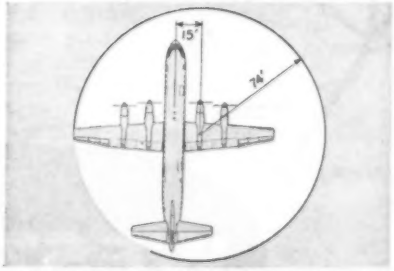
the new

DOUBLE-DECK JET-PROP VANGUARD

10 TONS OF FREIGHT!
The Vanguard's two giant lower deck cargo holds can carry 10 tons of the payload—with *no* modification in the passenger cabin above.



76, 86, 93, 120 PASSENGERS!
The upper deck passenger cabin has great layout flexibility . . . can easily be adapted to all first-class, mixed-class combinations or all tourist.



UTMOST PASSENGER COMFORT!
The Vanguard is an exceptionally comfortable airliner with the same jet-prop smoothness and the same big panoramic windows that have made the Viscount so popular.

EXCEPTIONALLY QUICK TURN-AROUND!
The Vanguard was designed to reduce time on the ground—allow *more time in the air!* Thanks to separate 5′ 6″-wide cargo hold doors and plenty of working space, freight can be loaded and unloaded simultaneously—and in record time. And, to speed passenger handling, there are two passenger doors—each with built-in folding stairs. Finally, the Vanguard has outstanding ground maneuverability—a minimal turning circle and good visibility—permitting faster, safer movement on crowded ramps.

425 MPH . . . 2500-MILE RANGE!
The Vanguard will be powered by four Rolls-Royce Tyne jet-prop engines. It will be capable of speeds to 425 mph, will have a range of 2,500 miles with a full payload of 25,000 pounds. Into each Vanguard will be built over 2 million flying hours of Vickers jet-prop experience. Experience has no substitute!

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Accessory Producers Are Hard-Pressed

IT IS HIGH TIME a few words were written about the plight, the contributions, achievements and the problems of the accessory equipment producer. He is the unsung hero (and often a martyr) of aircraft and missile development.

The technical challenge of keeping the U.S. out in front in all areas of the air is a formidable one. It is a challenge that weighs heavier on one key segment—the accessory equipment producer—than on all others.

It is upon the accessory field that all demands for lighter weight components, more reliable performance, more durable materials, come to rest.

Yet it is a segment of industry hardest pressed by the forces of competition, the limitations of military security which prevent free interchange of ideas and the whims of the Pentagon budget axe-wielder.

The importance of the accessory equipment producer is manifest. The strategic utility of an $8-million multi-jet bomber can be severely limited, if not erased, by an item so relatively insignificant as an alternator flywheel. Or the operation of a military fighter or airline transport is canceled out because of the leakage of a single fluid line.

Under the stress of persistent demands for quality-plus products, the aircraft and missile accessory manufacturer lives in day-to-day combat with the problems of unraveling data from an overly-confused and never-current system of military specifications. And he lives in constant apprehension as to his future under a not-too-clearly defined "weapons system concept" of tomorrow.

Last, and not the least important item in his hectic life, the accessory producer exists under the continuing pressure of competing for a contract and investing his own R&D capital to improve his competitive position. The hazards are very considerable and the hope of monetary return often vanishes overnight.

Even in the commercial field the accessory equipment producer lives a precarious existence. Even at this late date in commercial jet planning there still exists within airline managements some strongly diverse opinions as to whether jets will be taxied or towed into passenger ramps. Airlines are not inclined to buy "paper" designs; they want to see and try out prototype equipment before investing in volume orders. But by the same token the equipment producer is not inclined to carry paper designs into working projects without some sort of assurance of an eventual market.

Yet the truth is that a great many accessory equipment producers do invest capital in projects with the most risky sort of chance of getting a return. And it is because of this risk that there has been such a widespread development throughout the accessory equipment field on which so much in aviation depends.

The recent wave of cutbacks in military aircraft has hit deeply in the accessory equipment field. Many of these contracts had been won at much expense on the basis of continuing volume of production. The squeeze has been rough. Add to this the lack of guidance and clear programming by the Pentagon, and the accessory equipment producer finds himself in a tough spot today.

But the future commercial and military market, however confused, is to be a substantial one. Struggling against odds is nothing new for the accessory segment, as witness the initiative and development work of Vickers in the hydraulic field, AiResearch in air conditioning and pressurization, Jack & Heintz in starters, and Collins, Wilcox, Eclipse-Pioneer, Sperry and Bendix in instruments and electronics, to name only a few.

This is the 1957 edition of AMERICAN AVIATION's Engineering and Development Issue, bringing into the spotlight the most versatile, but least publicized, element of the over-all aviation industry. Throughout these 148 pages, the editors under direction of Joseph S. Murphy, have brought together into one volume an engineer's handbook of accomplishments of this industry—the new products, materials and equipment it has produced to meet the demands of aircraft and missiles of today and tomorrow.

The net result is an impressive display of creativity and productivity in aircraft and engine accessories, instruments, electronics, electrical equipment, furnishings, ground support and test equipment. To the more than 400 companies that cooperated in making this great issue possible, our particular thanks.

Wayne W. Parrish

CONVAIR Flies the World Over with STRATOPOWER Hydraulics

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The 1000th Convair has just been delivered — equipped with STRATOPOWER hydraulic pumps. Its owner will find what other airlines have found — that STRATOPOWER pumps provide reliable hydraulic power flight after flight.

At the latest check of their complete fleet operation, Delta found that more than one-fourth of their STRATOPOWER pumps have over 4000 hours of flight time. The *average* for all STRATOPOWER pumps in the Delta Airlines fleet is 2553 hours.

Western Airlines found out the success other users of STRATOPOWER pumps were having on Convair 340's and 440's and converted their *entire* fleet of 240's to the advantages of STRATOPOWER.

Whether or not you are flying Convairs, STRATOPOWER hydraulic power is available to you. Every major builder of commercial airliners in the country is utilizing STRATOPOWER hydraulic power on one or more of their latest models. Incidentally, kits are available to convert your 240's to the advantages of STRATOPOWER.

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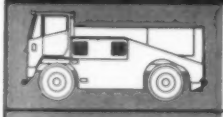
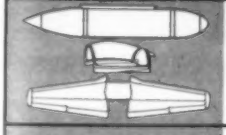
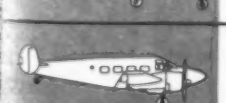
CAPABILITIES . . . Manpower, Tools and Experience

BEECH BUILDS	
	MA-3 MULTI-PURPOSE VEHICLES
	C-26, MD-3 POWER UNITS
	TANK-WING-MAJOR SUBASSEMBLY SUBCONTRACT PRODUCTION
	BEECHCRAFT T-34 TRAINERS
	BEECHCRAFT L-23 TRANSPORTS
	4-PLACE BEECHCRAFT BONANZA
	6-PLACE BEECHCRAFT TWIN-BONANZA
	8-PLACE BEECHCRAFT SUPER 18

The Navy's XKDB-1 target plane, shown above, was Beech Aircraft's first major project in the missile field. Its evaluation has revealed high performance in stability, controllability, and launching and recovery.

Beechcraft engineers are currently developing a whole family of rocket and turbo-jet powered drones. One of these, the Model 1013, can be equipped with multiple camera installations for both day and night observation. It also has the alternate capability of delivering tactical supplies to isolated combat units.

Other Beech projects include research and development work on launching and recovery systems for missiles, drones and manned aircraft; engineering test programs on aircraft emergency escape systems; and classified projects in the advanced fields of aerodynamics, cryogenics, thermodynamics, and aircraft range extension.

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To guard lives and to save taxpayers' money on its globe-girdling operations, the Military Air Transport

MATS utilizes Skydrol for proved

MATS made a thorough examination of fire-resistant Skydrol before selecting it for the cabin superchargers of all Douglas C-118A's. Now MATS has been using Skydrol for three years—around the globe, at high and low altitudes, at arctic temperatures, in desert heat and in jungle dampness. No matter where it flies, MATS knows Skydrol will be there to do its job because Skydrol is available the globe over.

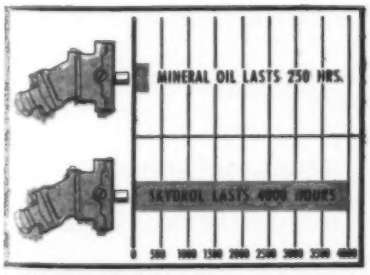
Today more than 700 airplanes in the world's major airlines are protected by Skydrol. They have logged over 7,500,000 flying hours. This is impressive proof of Skydrol safety, especially when you consider how many hydraulic leaks occur in the average big plane per flight.

Consider how many hydraulic fluid leaks in fire-sensitive areas show up in *your* planes per month. Skydrol is the key to peace of mind about these hydraulic fluid leaks . . . it is a fire-resistant, lubricating chemical, not an oil . . . and the world's only fire-resistant hydraulic fluid approved by the C.A.A.

JET OR PISTON-POWERED—there's a Skydrol for every type of aircraft. It's just farsighted safety and good business to order all *new* aircraft equipped with Skydrol. And conversion of present fleets to Skydrol is easy and costs comparatively little at overhaul time.

Service utilizes Skydrol fire-resistant hydraulic fluid for superchargers of its Douglas C-118A's.

protection from hydraulic fluid fire



LONGER SERVICE LIFE—Actual use in the Douglas supercharger shows excellent chemical and thermal stability of Skydrol . . . it stretches service life up to 16 times that of conventional hydraulic fluid.

39 MAJOR AIRLINES NOW SPECIFYING SKYDROL . . .

LAI	Panagra	Pan American
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CMA	American	Alaska Airlines
KLM	Braniff	A.V.B. (Brazil)
LAN	Delta	Ethiopian Airlines
TAI	Northeast	T.C.A.
UAT	Northwest	S.A.S.
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ATLANTA – CHICAGO
ATLANTA – CINCINNATI
ATLANTA – MIAMI
ATLANTA – HOUSTON
ATLANTA – NEW ORLEANS
ATLANTA – JACKSONVILLE
ATLANTA – DALLAS
ATLANTA – BIRMINGHAM
BIRMINGHAM – DALLAS
HOUSTON – ST. LOUIS
HOUSTON – NEW ORLEANS
CHICAGO – MEMPHIS
CHICAGO – ST. LOUIS
CHICAGO – NEW ORLEANS
CHICAGO – CINCINNATI
CHICAGO – MIAMI
NEW ORLEANS – DALLAS
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HAVANA – CARACAS
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*one way

Giant landing gear test facility is 60 feet high. It simulates conditions that heavy, high-speed planes actually meet.

BENDIX SHOOTS LANDINGS INDOORS TO HELP PRODUCE BETTER LANDING GEAR SYSTEMS

When designing and producing complete landing gear systems it is vitally important to know in advance just how every component part will respond to the stresses and strains of flight conditions.

That's why the giant landing gear testing equipment pictured above plays such an important part in the development and production of Bendix* complete landing gear systems.

All major components that make up the system such as control valves, nose wheel steering, retractor actuators, power braking as well as wheels, brakes, shock absorbing struts and even tires are subjected to repeated tests of braking, dropping, twisting and vibration before final approval.

For Bendix has proven over many years that landing gear components that have been designed, engineered and tested to work together give better and more dependable performance than any arbitrary assembly system.

So, when it comes to gear for landing, think and plan in terms of a complete landing gear system. Then, we suggest you think of Bendix and Bendix Products Division at South Bend, Indiana.

*REG. U. S. PAT. OFF.

Bendix PRODUCTS DIVISION South Bend, IND.

Bendix AVIATION CORPORATION

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NOW FLYING!

THE NEW LOCKHEED

JETSTAR

a swept-wing "economy size" jet
that can match the performance of
large jet transports...
but at a fraction of their costs!

Designed for a variety of Jet Age military missions, the Lockheed JETSTAR is a 4-engine utility jet transport that flies 500/550 mph, at altitudes of 25-to-45,000 feet, 2,000 statute miles and more.

Amazingly quiet (due to the aft fuselage mounting of engine jet pods), the new JETSTAR is an ideal aircraft for economical: *bomber pilot transition • in-flight refueling indoctrination • bombardier training • ECM training*

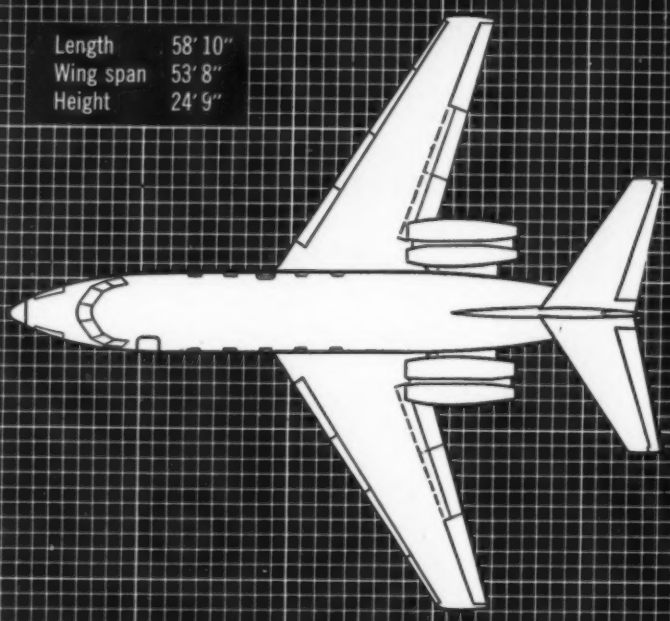
LOCKHEED

First flight of the JETSTAR (powered by two Bristol Orpheus engines with a total takeoff thrust of 10,000 pounds) was made September 4, at Edwards AFB. A second prototype, scheduled for flight early in 1958, will be powered by four General Electric J-85 or Fairchild J-83 engines.

high-altitude photographing • airways systems inspection • high priority cargo/passenger transportation • tow-target aircraft • navigator training.

Like all Lockheed planes, the new JETSTAR is easy to maintain and economical to operate. And it has the inherent stamina to insure optimum utilization and long life—qualities that are more important in military aircraft today than ever before.

Length	58' 10"
Wing span	53' 8"
Height	24' 9"



D means leadership

Lockheed Aircraft Corporation
Georgia Division, Marietta, Ga.

VICKERS®

miniaturized motorpumps

...for Vanguard Earth Satellite Rocket Vehicle

Numerous Vickers miniaturized hydraulic airborne components have been successfully developed for missile use without sacrifice of their inherent high efficiency and reliability. Representative of the "packaged" approach to dependable missile hydraulic power is the PFM-3906 constant displacement piston type pump shown here mounted on an electric motor. The pump has a theoretical delivery of 0.84 gpm at 7400 rpm and 1000 psi with a volumetric efficiency of 95%. The explosion proof motor has 6.0 in.-lb. torque from 6900 to 9000 rpm. The complete package weighs 8 lb. . . . 1 lb. for the hydraulic pump and 7 lb. for the electric motor. **The overall length is less than 10 inches.** For further information about Vickers miniaturized hydraulic components and complete packages, ask for Bulletin A-5216.

7886

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Circle No. 139 on Reader Service Card.

WHEN—WHERE

OCTOBER

IRE national symposium on engineering writing and speech, Sheraton-McAlpin Hotel, New York, Oct. 21-22.

IAS meeting, Canadian Aeronautical Institute, Montreal, Oct. 21-22.

National Safety Congress, Conrad Hilton Hotel, Chicago, Oct. 21-25.

World conference for aviation, Sao Paulo, Brazil, Oct. 22.

Dedication ceremonies, Love Field, Dallas, Oct. 23-27.

Computer applications symposium, Armour Research Foundation, Harrison Hotel, Chicago, Oct. 24-25.

Aircraft Electrical Society aviation display, (invit. only), Pan Pacific Auditorium, Los Angeles, Oct. 24-25.

Association of the U.S. Army, annual meeting, Sheraton-Park Hotel, Washington, Oct. 28-29.

East coast conference on aeronautical and navigational electronics, IRE, Fifth Regiment Armory, Baltimore, Oct. 28-30.

American Nuclear Society, second winter meeting, Henry Hudson Hotel, New York, Oct. 28-31.

Aviation Electrical Equipment Display, U.S. Grant Hotel, San Diego, Oct. 30.

Air Traffic Control Assn., annual meeting, Marott Hotel, Indianapolis, Oct. 30-Nov. 1.

NOVEMBER

World Metallurgical Congress and National Metal Exposition, Palmer House, Hotel Sherman, International Amphitheatre, Chicago, Nov. 2-8.

Institute on Electronics in Management, (automatic data processing systems), The American University, Washington, D. C., Nov. 4-8.

Joint military-industry guided missile reliability symposium, Naval Air Missile Test Center, Pt. Mugu, Calif., (those with secret clearance only), Nov. 5-7.

Third Aeronautical-Communications Symposium, IRE-PGCS, Utica, N. Y., Nov. 6-8.

Weapon system management meeting, IAS, Statler-Hilton Hotel, Dallas, Nov. 7-8.

Air Traffic Conference, fall meeting, ATA, Key Biscayne Hotel, Miami, Nov. 11-13.

Instrumentation conference and exhibit, IRE, Biltmore Hotel, Atlanta, Nov. 11-13.

Vickers, Inc., hydraulics conference, Park Shelton Hotel, Detroit, Nov. 12-13.

IRE, Mid-America Electronics Convention, Municipal Auditorium, Kansas City, Mo., Nov. 13-14.

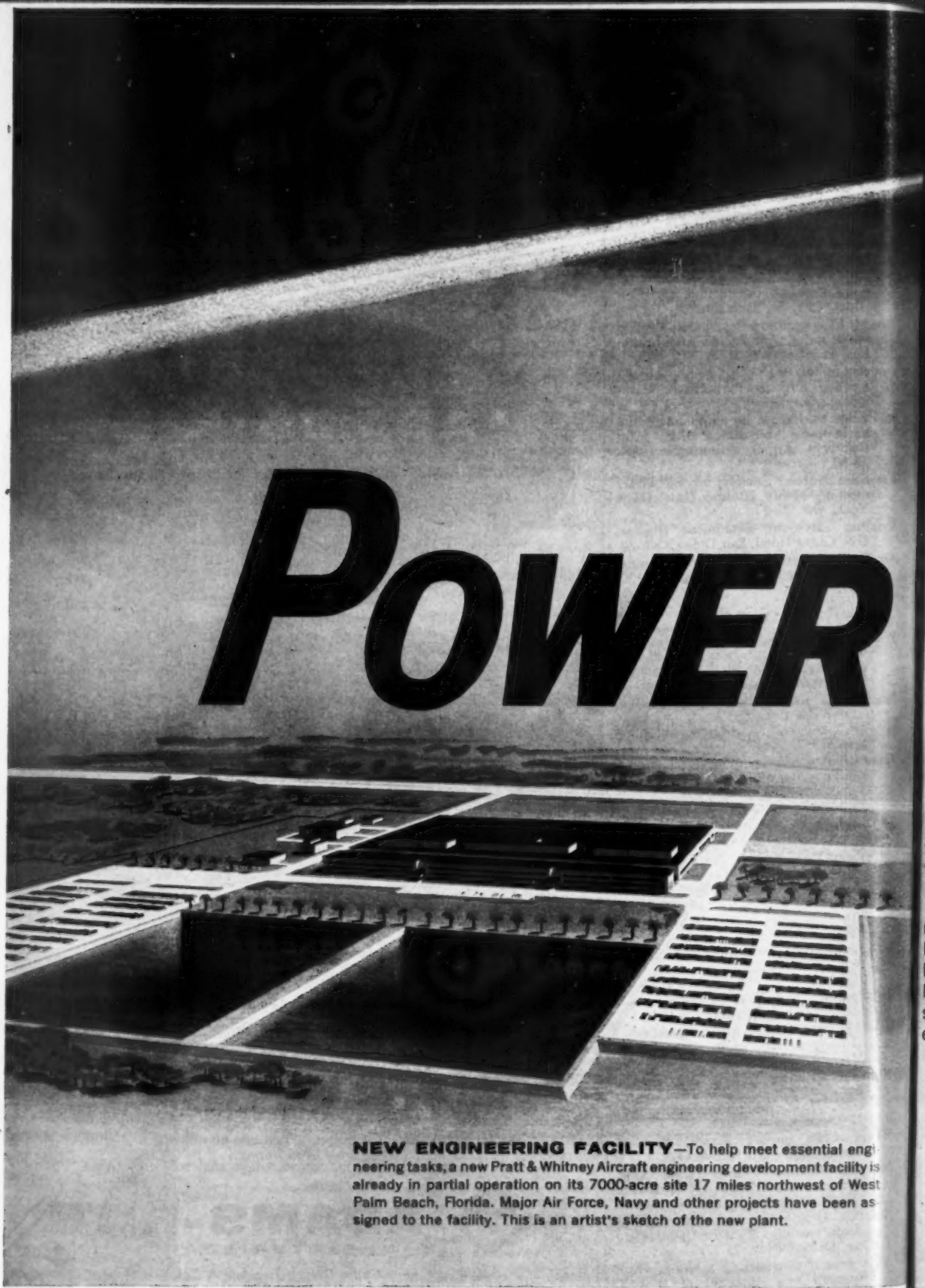
National Aviation Trades Assn. convention, and National Air Taxi Conference, Hotel Adolphus, Dallas, Nov. 13-15.

Wings Club annual dinner, Waldorf-Astoria, New York, Nov. 18.

National Defense Transportation Assn., convention and forum, Shoreham Hotel, Washington, D. C., Nov. 18-21.

Aviation Distributors and Manufacturers Assn. meeting, Sheraton-Cadillac Hotel, Detroit, Nov. 21-22.

ATA annual membership meeting, Washington, D.C., Nov. 26.



NEW ENGINEERING FACILITY—To help meet essential engineering tasks, a new Pratt & Whitney Aircraft engineering development facility is already in partial operation on its 7000-acre site 17 miles northwest of West Palm Beach, Florida. Major Air Force, Navy and other projects have been assigned to the facility. This is an artist's sketch of the new plant.

for new aircraft...
in whatever form it takes—

Few activities in aviation today exceed the significance of new developments in the power plant field.

Among these developments are the mighty J-75 turbojet, now in production for big commercial jet transports and a number of very high performance Air Force and Navy combat aircraft . . . advanced, still-secret turbine projects . . . and entirely new engines of the future.

To meet the technical challenges these developments present in every field of science and engineering, Pratt & Whitney Aircraft is backing more than 30 years of engine experience with the industry's most advanced privately-owned research and development facilities.

In whatever future form aircraft power takes . . . in new materials, new fuels, or even entirely new systems of aircraft propulsion, Pratt & Whitney Aircraft will continue its leadership in aircraft engine design and production.

Pratt & Whitney Aircraft

Division of United Aircraft Corporation, East Hartford, Connecticut

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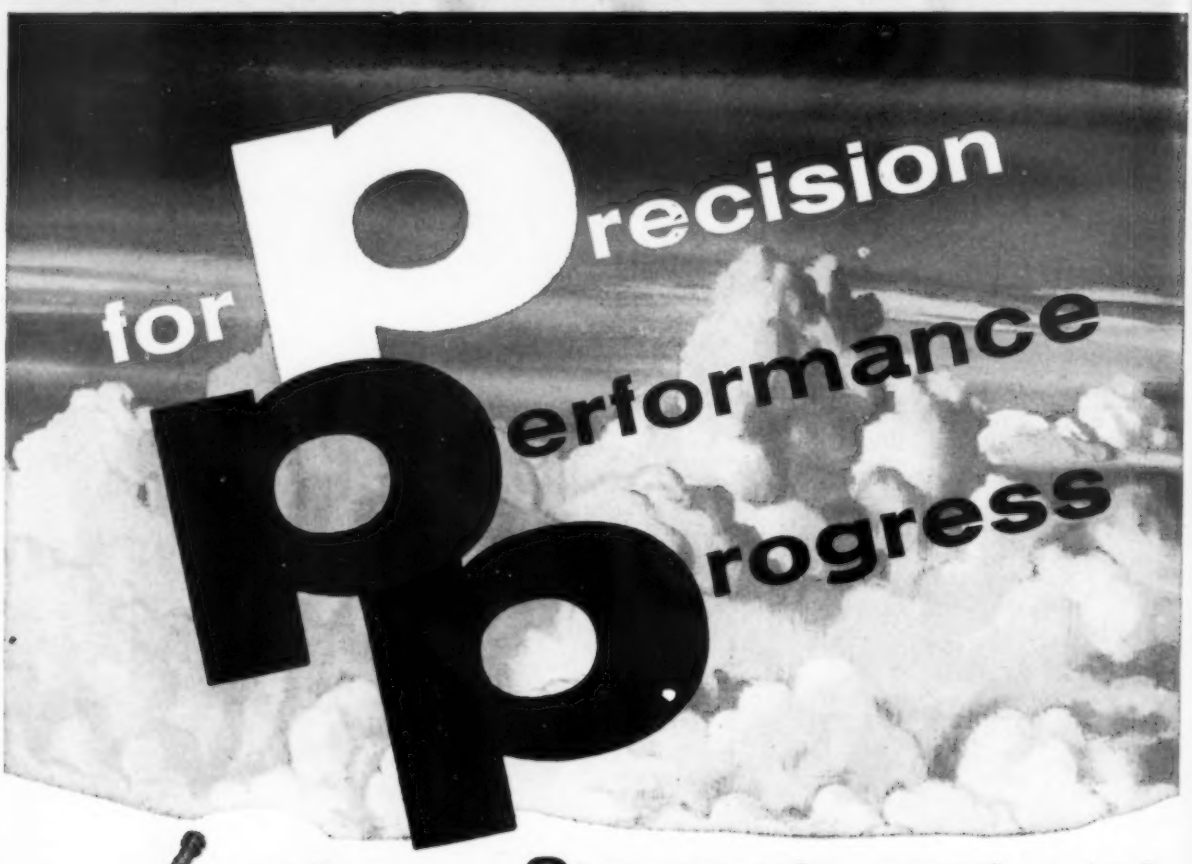

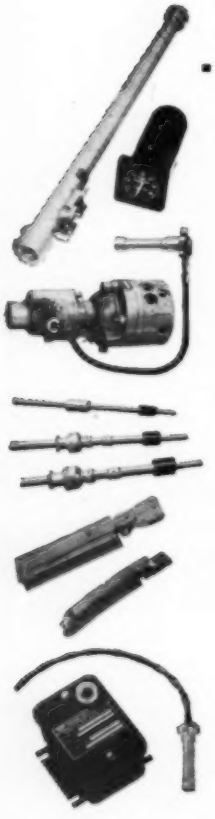

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ELECTRONIC • HYDRAULIC • MECHANICAL

Lightweight Pacitron Fuel Gage Systems: Fuel measurement and management systems incorporating latest technological improvements. Consistent reliability and dynamic progress are typified by the Load Limit Control, Center of Gravity Control and new True Mass Fuel Gaging System. Specification of Pacitron in latest military and commercial aircraft emphasizes Simmonds' continued leadership.

Simmonds SU Fuel Injection Systems: The only advanced type fuel injection system now in production for medium h.p. gasoline engines, the SU System has been proven in field tests to give economies up to 25%. Eliminates icing problems, gives improved cold starts.

Precision Push-Pull Controls: Simmonds Push-Pull Controls are positive, precise and rugged. Capable of heavy loads and accurate operation under vibration, continuous cycling, temperature extremes, etc. Proved in millions of miles of service on aircraft engines, pressurized doors and specialized applications.

Cowling and Access Latches: Heavy duty flush fitting aircraft latches for installation on cowlings and access panels. Two-piece toggle type, available to fit a wide range of structural curvatures; for attachment of plastic radomes, etc.

Liquid Level Sensing Systems: Working independently of the fuel gage system, this thermistor sensing system indicates accurately the precise time at which fuel, oil or other liquid goes above or below any designed level. It also automatically stops or starts pumps or valves to transfer the liquid from one tank to another. The system is rugged, has no tubes or moving parts, is light and compact. Operates on military aircraft fuels and oils.

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The exciting 500 mph Caravelle—the only twin turbojet airliner flying in the free world today.

THE ONLY OIL APPROVED FOR THE WORLD'S MOST ADVANCED TURBINE AIRLINERS!

ESSO AVIATION TURBO OIL 35

Anticipating by many years the need for an entirely new *synthetic* lubricant, Esso researchers, working in close association with the British Ministry of Supply and engine designers and builders, produced Esso Aviation Turbo Oil 35—a synthetic oil that met and exceeded the stringent lubrication requirements of turboprop and turbojet engines.

The development of this product is a typical example of Esso's continuing leadership in turbojet lubrication.

ESSO AVIATION TURBO OIL 35—the one engine oil for these modern aircraft of today and tomorrow:

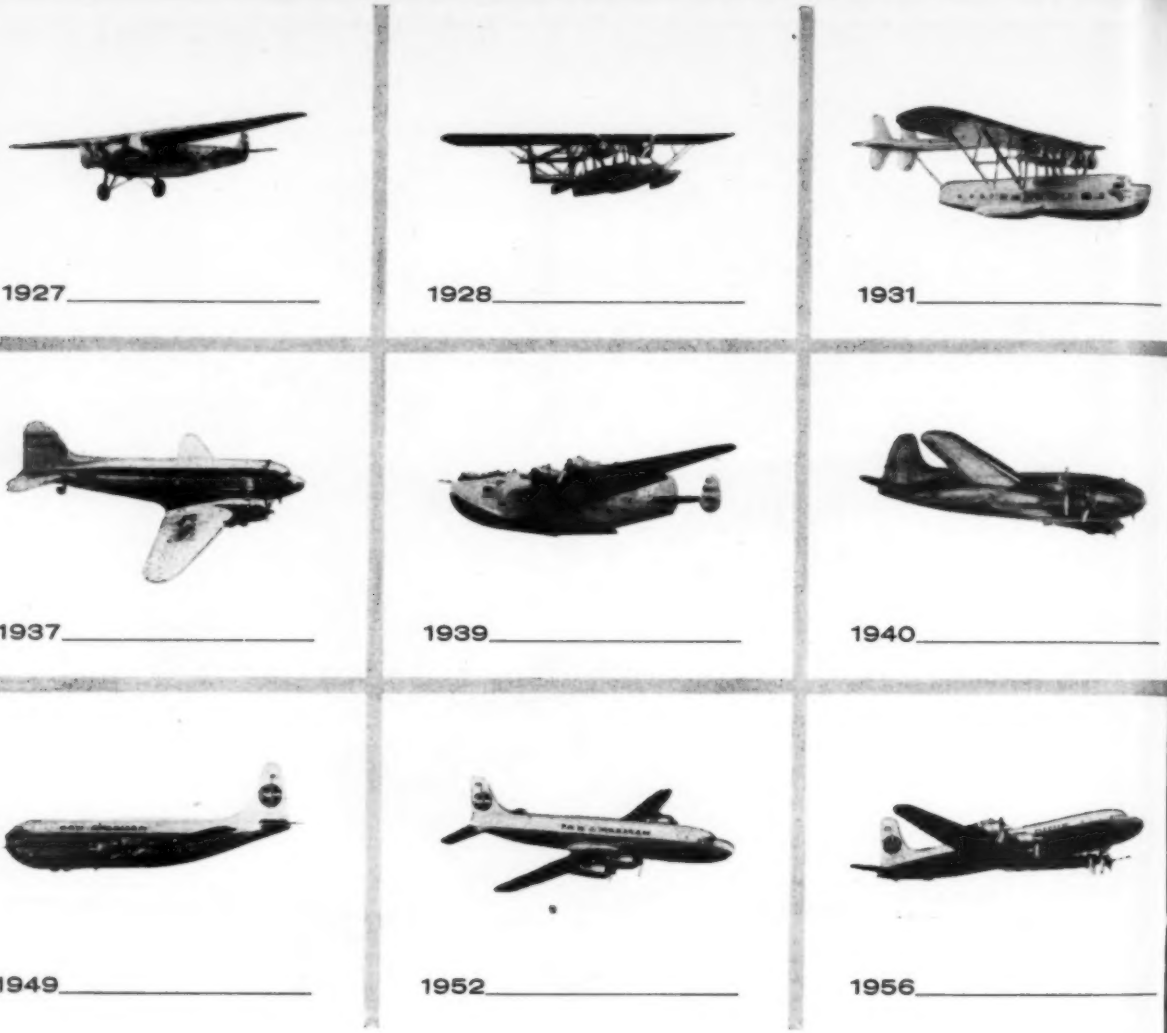
	POWERED BY:
Vickers Viscount	*Rolls-Royce Dart*
Sud-Aviation Caravelle	*Rolls-Royce Avon*
Bristol Britannia 300 Series	*Bristol Proteus 755*
Fokker/Fairchild F-27	*Rolls-Royce Dart*
DeHavilland Comet IV	*Rolls-Royce Avon*
*Boeing 707**	*Rolls-Royce Conway*
*Douglas DC-8**	*Rolls-Royce Conway*

8 OUT OF EVERY 10 OF THE WORLD'S INTERNATIONAL AIRLINES USE

ESSO

AVIATION PRODUCTS

***Esso Aviation Turbo Oil 15, a lighter viscosity grade, is recommended by Pratt & Whitney Aircraft for the JT-3 and JT-4 engine models which have been selected by many airlines to power their 707 and DC-8 aircraft.**



30th Anniversary

On the morning of Oct. 28, 1927, a staccato roar of engines ushered in an era in commercial aviation—the Stars and Stripes flew in international skies.

The first Flying Clipper,* a Fokker F-7, lumbered into the air at Pan American Field, in Key West bound for Havana, Cuba—90 miles away across the Straits of Florida.

Since then the parade of Pan American Clippers has swiftly extended its wings to embrace the earth—wings that have changed from the 100-mile-an-hour variety, to swept back jobs that nuzzle the speed of sound. And Pan American has earned its place as pace-setter in the skies: aircraft research, engine analyzers, reduced air fares, jet stream studies, the creation of and insistence on the standards that have made the slogan—*The World's Most Experienced Airline*—an international reality.

Behind Pan Am's relentless attempt to attain perfection is the philosophy of this airline. A philos-

1934_____

1935_____

1935_____

1945_____

1947_____

1948_____

1958_____

1959_____

TEST YOUR SKILL—

A. SIKORSKY S-38
B. BOEING 314
C. DOUGLAS DC-4
D. BOEING 707
E. LOCKHEED L-749
F. FOKKER F-7
G. SIKORSKY S-42
H. DOUGLAS DC-7C
I. CONVAIR 240
J. BOEING 307
K. DOUGLAS DC-8
L. MARTIN M-130
M. DOUGLAS DC-2
N. SIKORSKY S-40
O. DOUGLAS DC-3
P. BOEING B-377
Q. DOUGLAS DC-6B

ANSWERS AT BOTTOM

Clipper Quiz

opby that is essential to stimulating the growth of the aviation industry—make the magic of air travel available to every man.

30 years of leadership

In the past 30 years Pan American's skyway has grown from that first 90-mile flight to encompass 82 lands on 6 continents around the world. In the next 30 years, we can merely hazard guesses and dreams—but whatever progress develops, Pan American will be, as in the past, in the forefront of international aviation.

TRADE-MARK, REG. U.S. PAT. OFF.

* * *

ANSWERS: 1927-F; 1928-A; 1931-N; 1934-G; 1935-M; 1935-L; 1937-O; 1939-B; 1940-J; 1945-C; 1947-E; 1948-I; 1949-P; 1952-Q; 1956-H; 1958-D; 1959-K.

The first responsibility of an airline is to be a useful citizen.

PAN AMERICAN

Revolutionary design...and accuracy to ¼° per hour

In a fully maneuverable twin gyro platform utilizing completely new gyro design principles, Sperry has achieved unprecedented accuracies in heading information and all-attitude flight. The first of these new Sperry systems will soon be delivered to the Air Force's Wright Air Development Center.

This Sperry system provides azimuth drift rate as low as 1/4° per hour, and in the vertical axis, 1/10° per minute. The use of twin directional gyros and new design technique permits this extreme accuracy as it minimizes the disturbance torques inherent in conventional gyros. The low drift in the vertical axis minimizes turning error—permits freedom from erection control for longer periods of time.

Coupled with doppler radar navigators, the CEP (Circular Error Probable) is materially reduced due to exceedingly low drift inertial heading feature. The inertial heading output permits either Great Circle or Rhumb Line flight paths.

The compactness of the twin gyro system makes it extremely reliable and easy to maintain. No warm-up period is required due to the balanced thermal construction and the absence of fluids.

The twin gyro platform has been designed to provide control information for complete and full maneuverability of high-performance aircraft without limit. Its full stabilization in all attitudes makes it especially adaptable for Low Altitude Bombing Systems, fighter maneuvers and missile applications.

Write our Aeronautical Equipment Division for further information.

FEATURES

Low Random Drift
Inertial Heading
Great Circle or Rhumb Line Output
No Gimbal Error
Low Turning Error
Multiple Roll-Pitch-Heading Output
Compact
Rugged
No Warm-up Time
Light Weight

Platform	*18 lbs.*
Servo Amplifiers and Heading Computer	*8 lbs.*

AERONAUTICAL EQUIPMENT DIVISION

SPERRY GYROSCOPE COMPANY
Great Neck, New York
DIVISION OF SPERRY RAND CORPORATION

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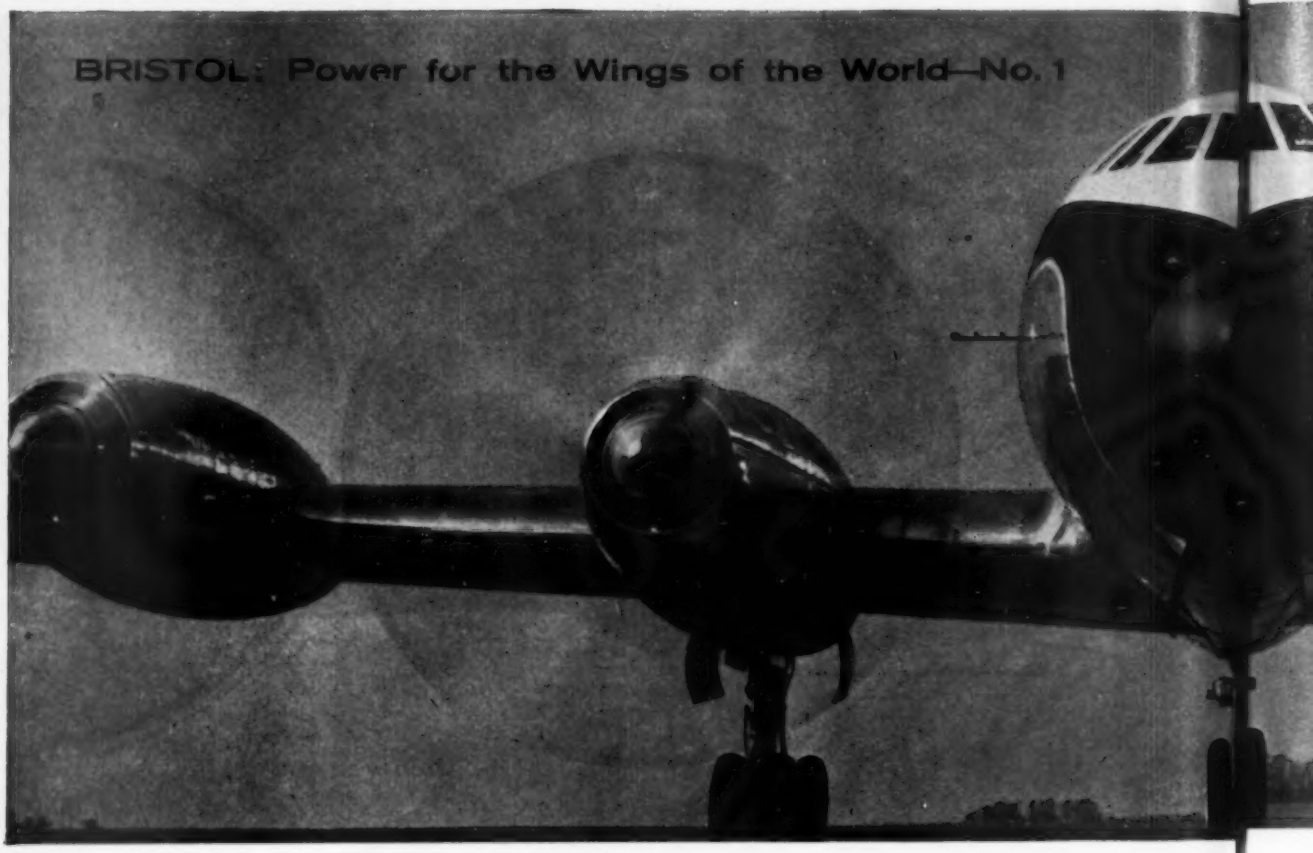
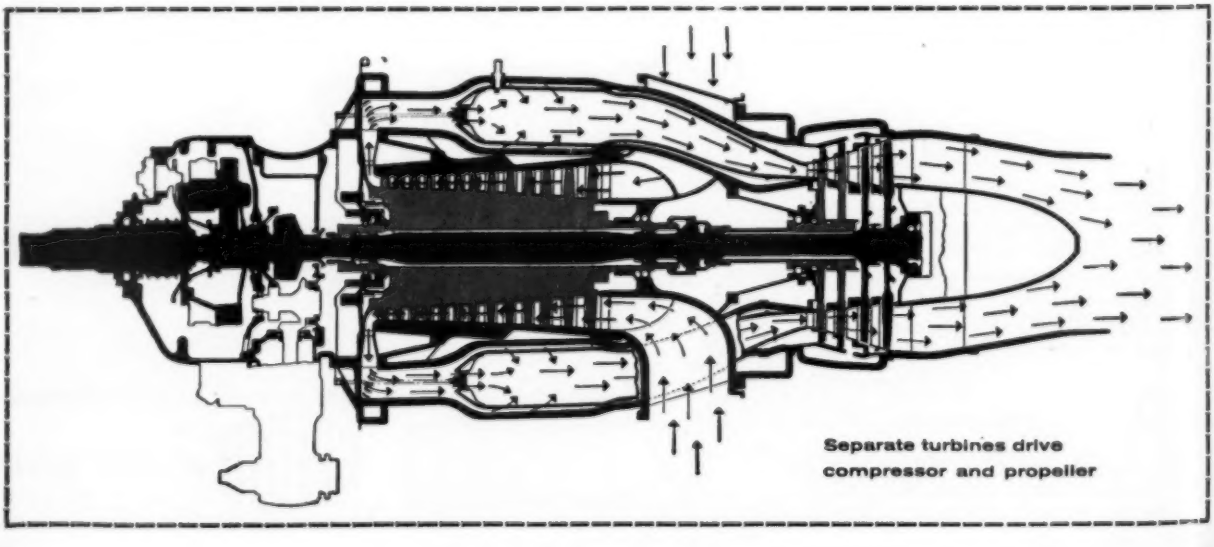


THE REVOLUTIONARY BRISTOL PROTEUS

Most powerful engine in airline service, cuts fuel costs, solves noise problem



Bristol's pioneer free-turbine principle has been proven by actual performance. Powering the Bristol Britannia today, the Proteus delivers greater horsepower than any other engine in airline service—and, with a specific fuel consumption of only 0.445 lb/ehp/hour, is by far the most economical gas turbine in either civil or military service.

Pioneer Free-Turbine Design Impresses US Aviation World

US aviation experts who recently examined the Bristol Britannia were greatly impressed by the power, quiet, and all-round performance of her four mighty Proteus engines. This engine's remarkable flexibility is the result of an imaginative engineering concept . . . the revolutionary free-turbine principle, designed and developed by Bristol.

In the Proteus engine, the compressor and propeller are driven by separate two-stage turbines. There is no mechanical connection between the two systems, only a smooth gas stream.

Variations in propeller speed impose no limits on the output of the compressor and its turbine. The gas-producing section and propeller can each operate at optimum efficiency under all flight conditions, unlike the more limited single-shaft turboprop engine. It is because the Proteus' propellers turn so slowly that the Britannia, although much the most powerful, is the quietest airliner flying today.

World's Largest, Fastest, Quietest Jet-Prop Airliner Demonstrates Proteus Superiority

The Proteus is a revolutionary power unit for revolutionary times. It is a dramatic illustration of Bristol's engineering leadership, one of a long line of world-famous aero-engines. The Proteus combines great power with unrivalled economy, versatility, and low noise levels.

The Proteus powers the Bristol Britannia—world's largest, fastest, quietest jet-prop airliner—flying over 100,000 miles a week on BOAC routes throughout half the world. The reliability of the Proteus has been convincingly demonstrated by its outstandingly rapid increase in overhaul life since introduction into world service early in 1957. Moreover, maintenance requirements have proved to be far below those of piston engines.

BRISTOL

Aero-Engines

BRISTOL AERO-ENGINES LIMITED · ENGLAND

SPOTLIGHT

Horizons Inc., Cleveland research organization, received Wright Air Development Center contracts to develop coating techniques for columbium (niobium), and to find a new inorganic laminate for radomes. Under the columbium contract, coatings must prevent base-metal oxidation up to 2,500°F. Specs for new laminate call for 1,000°F temperature-resistance, plus a high strength-weight ratio.

NACA scientists believe an increase of more than 350°F in the limiting temperature of turbine blades can be achieved in the space of a few years if the U.S. is willing to pay for the advance. But they admit it has taken 10 years to get a 300° boost in blade temperature to the present level of 1,650°F.

United Aircraft anticipates a special problem in revamping its operations to fit USAF's new ceiling on monthly payments. While UAC can carry part of the load of its programs, it must first ascertain whether its airframe customers can also meet their original programs.

Grumman's airborne early warning aircraft—successor to its S2F—has been slipped to fiscal 1959 because of Navy funding problems. Aircraft will be powered by Allison T56 turboprop engines.

At least some large aircraft companies believe Air Force should help them out with their renegotiation problems—especially now that companies are going to help Air Force keep its programs going within the expenditure limitation.

Airways Modernization Board is not involved with recent contract to consultant firms for choice of site for second Washington airport, as is mistakenly believed. Project is responsibility of E. R. Quesada as President's assistant for aviation facilities planning and has nothing to do with AMB in its pursuit of technical solutions for ATC system of future.

Flying crane and one-man helicopter developments are victims of the Defense spending economy. Although the military was intrigued with the concepts, it now has been determined that there is no strategic requirement for either. McDonnell Aircraft has canceled its own financing of the flying crane airframe. But Navy will continue its support of the large rotor system for possible future applications to new helicopters. Hiller may continue its research on one-man rotor systems, but future military financial support—after present allocations are gone—can no longer be forthcoming.

North American has received its initial Phase I contract for development of the new USAF long-range interceptor which has the No. 2 priority for manned weapon system development. Contract is for about $2 million initially, may get more funds later in the fiscal year. New LRI has been given the YF-108 designation. Weapon system designation for which NAA is manager is WS-202A.

Some Pentagon sources say Boeing moved B-52 production to Wichita in anticipation of receiving the WS-110A contract for its ample Washington (state) facilities. However, North American, other principal competitor for the chemically-fueled bomber, now has ample facilities for mass production of the project—its closed Fresno division and the Columbus (Ohio) division.

Dual cycle engine for the now defunct Republic XF-103 development program had featured components of the Curtiss-Wright J67 (canceled by Air Force two years ago) as the turbojet section of its turbo-ramjet power package.

Navy has decided to participate with Army in competition for a three-ton helicopter, though basically a top priority Army requirement only. Air Force may go along for the ride, although any ultimate USAF procurement would be very small.

A Civil Aeronautics Administration report due soon on tests of the military Volscan radar-computer landing aid will show that the system is not satisfactory for high capacity civil terminals hemmed in by other terminal areas. Controllers reportedly have more to do than with the present system and Volscan requires too much airspace.

Peace is his profession

For more than a decade the officers and airmen of the United States Air Force *Strategic Air Command* have waged *peace* with all the vigor and resolution the military once gave only to war. The survival of our civilization in which freedom of religion, education, art, science and government flourishes, depends today upon the men who are practicing *peace* as a *full-time* profession. In this restless world these professional men are actively dedicated to our way of life!

PUBLISHED AS A PUBLIC SERVICE BY CONVAIR, A DIVISION OF GENERAL DYNAMICS CORPORATION

the BIG REACH

A Fistful of Business for YOUR Airline, Too!

Record-breaking air freight volume welcomed Flying Tigers' new "Big Reach" service. This is a greatly improved kind of service. Delivery of Flying Tigers' new *fleet* of Lockheed all-cargo Super-H Constellations makes it possible.

The Super-H now is the world's champion airfreighter. It outperforms the former "champ" by a big margin. More lift—21½ tons. More speed – 331 mph. More range – 2,200 miles.

Super-H speed and range have made possible dramatic revisions in our schedules. New England and the Pacific Northwest now are served by transcontinental instead of "feeder" schedules. *All* flights, in fact, now are transcontinental, *and by Super-H Constellation!* Wherever you connect, you now connect with through service. We even have been able to arrange schedules so that, between virtually any two airports we serve, we are offering the fastest all-cargo service and greatest all-cargo lift of any airline.

No wonder the "Big Reach" has meant record-breaking volume . . . both one-carrier and interline. This is why we say the "Big Reach" can mean a fistful of business for *your* airline, too. You'll find working with Flying Tigers can be plenty profitable, too!

A dramatic full-color photo of the Super-H in flight is featured on Flying Tigers' free 1958 calendar. Drop us a line and we'll send you one.

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General Offices: Lockheed Air Terminal, Burbank, Calif.
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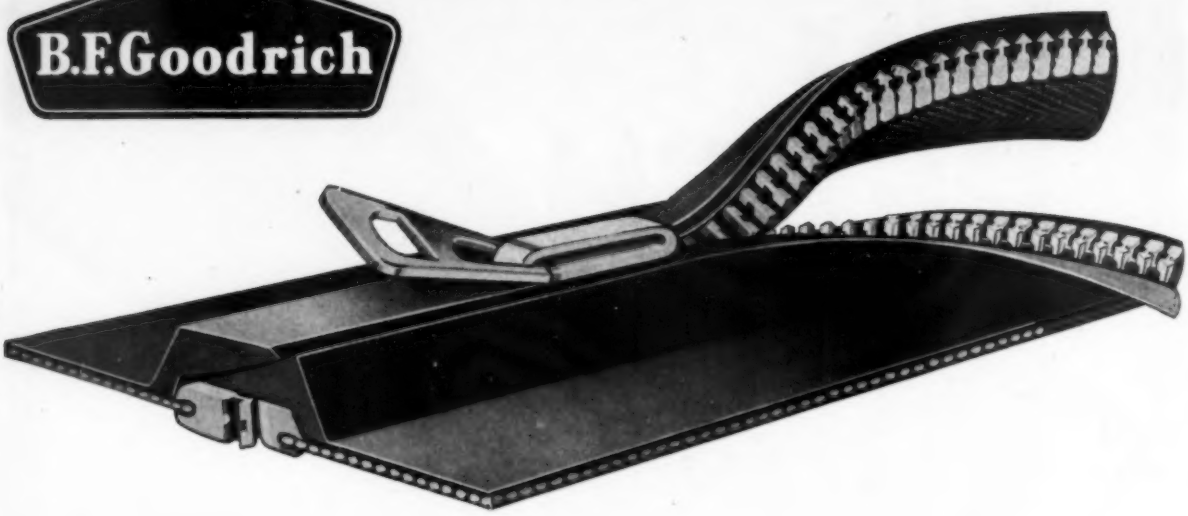
B.F.Goodrich



B. F. Goodrich zipper seals even tighter under pressure

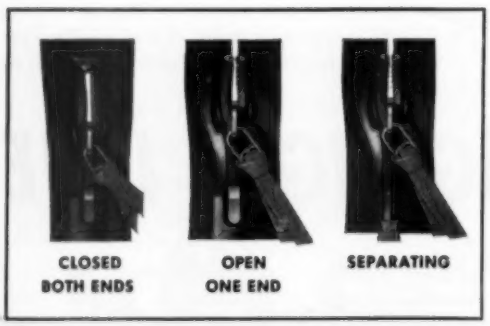
B. F. Goodrich Pressure Sealing Zippers are a completely different kind of fastener. They seal out dirt, fumes and liquids —yet zip open in seconds to provide easy access for servicing.

Notice how the molded rubber lips seal with hairline precision. Under external pressure they seal even *tighter*, withstand any pressure up to the maximum strength of the zippers themselves.

Pressure Sealing Zippers, made only by B. F. Goodrich, are used on air ducts, inspection ports, access doors, aileron gap seals, fume curtains, full pressure high altitude suits, and many other applications.

The Pressure Sealing Zipper is one more example of how B. F. Goodrich rubber research and engineering can solve difficult problems.

Baggage panels on Lockheed's Super Constellations zip open for easy access to equipment, provide strong, safe bulkheads that satisfy CAA regulations by resisting flame, abrasion, impact, and deterioration from oil and aging.



BFG Pressure Sealing Zippers come in three basic styles, designed to solve almost any tricky sealing problem. All sliders are non-locking and can be furnished with pull on the rubber lip side, metal scoop side, or both sides.

FREE—NEW DESIGN DATA BOOK. Shows styles, sizes, and approved applications. Gives complete instructions for installation. For your copy of "Pressure Sealing Zippers," write:

B.F.Goodrich Aviation Products
a division of The B. F. Goodrich Company, Akron, Ohio

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OCTOBER 21, 1957—VOL. 21, NO. 11

AMERICAN AVIATION

WORLD'S LARGEST AVIATION PUBLISHERS

Diversification . . .

How Hamilton Standard approached this major problem facing industry today; an exclusive interview with Erle Martin

by Henry T. Simmons

WHAT DOES a company do when it is faced with the long-term prospect of losing the bulk of its market?

This was the problem which confronted Hamilton Standard Div. of United Aircraft Corp. 10 years ago. Its answer to the problem may be summed up in a single word: diversification.

In 1947, Hamilton Standard was the largest U.S. manufacturer of propellers for military and commercial aircraft, but it foresaw a gradual drop in propeller demand as the new jet aircraft replaced piston-powered machines.

Drawing upon its long experience in the development and production of propellers and associated controls, the division commenced the introduction of a line of new products which today includes cabin air conditioning, pressurization and control systems, fuel controls, aircraft engine starters, pumps, refrigeration units and valves.

MARTIN

Hamilton Standard's program has been eminently successful. One-third of its total present sales stem from products other than propellers, and the percentage would be substantially higher if it were not for the surprisingly high demand that is continuing for piston-engine transport aircraft.

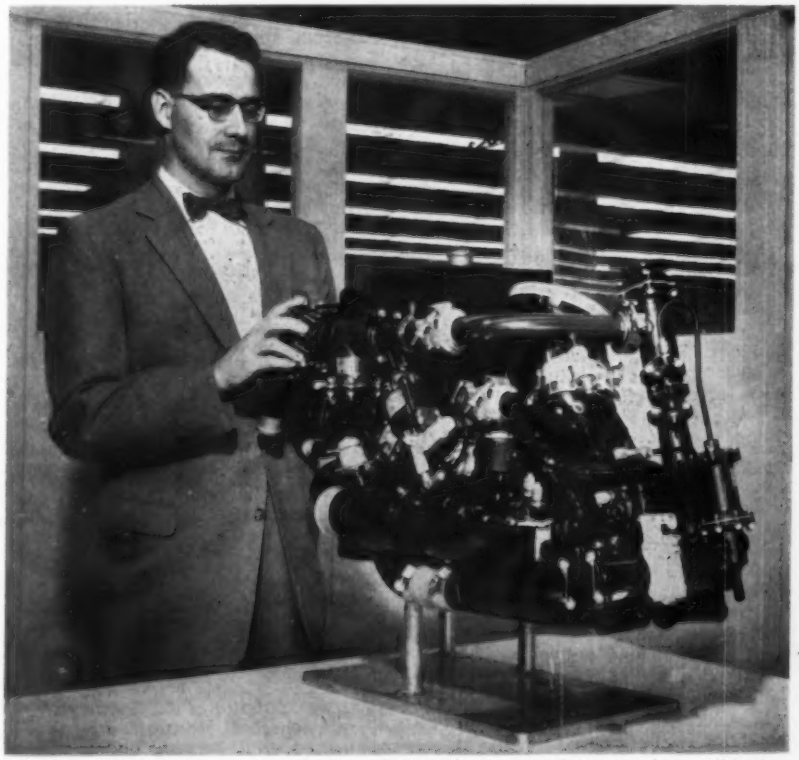
From the standpoint of engineering effort, approximately one-half of the division's engineering facilities and personnel are devoted to non-propeller projects.

Several important principles guide Hamilton Standard's selection of new products. The new items must be similar in complexity to the accessories the division has previously produced, they must involve similar technical problems, and they must fall in the $2,000 to $10,000 price range with which the division is most familiar.

These principles have probably contributed greatly to the success of Hamilton Standard's diversification—a program which is all the more remarkable in view of the generally unhappy experience of the aircraft industry with diversification endeavors since the end of World War II.

As for the future, Hamilton Standard is planning to continue its development and introduction of new products. It is looking into such things as cabin superchargers for jet transports, freon refrigeration systems for future bombers and fighters, constant speed drives and auxiliary power systems.

To tell the story of Hamilton Standard's diversification in more detail, AMERICAN AVIATION has interviewed Erle Martin, v-p of United Aircraft Corp. and gen. mgr. of Hamil-



EARL ADAMS, Hamilton Standard project engineer, examines an air conditioning unit developed for the Lockheed F-104B supersonic fighter.

ton Standard.

Martin graduated with an electrical engineering degree from Pennsylvania State University in 1929, joined Hamilton Standard in 1931, became chief engineer in 1935, engineering mgr. in 1940, gen. mgr. in 1946, and a v-p of United Aircraft in 1952. He holds 72 patents for propeller inventions.

Here is the verbatim text of the interview with Martin:

Q. What brought about the decision to diversity?

A. It was our belief that propellers would become a smaller and smaller part of commercial and military procurement. It was obvious that an increasing percentage of aircraft would be jet-propelled. As the world's leading suppliers of aircraft propellers we had become accustomed to having every airplane a potential customer. We felt left out of the jet picture. We decided to diversify in order to hold our level of operations and have some growth prospects.

Q. How was the decision reached?

A. The decision was reached by Erle Martin in consultation with United Aircraft Corp. officials, especially H. M. Horner, chairman, and with the senior people of Hamilton Standard, especially Charles M. Kearns, then engineering manager.

The decision was made in 1948, although we had given the idea serious consideration from the early part of 1947 and had been concerned about the problem of jet propulsion and its effects since June, 1944, when we first heard of the success of the jet engine.

Q. How long did it take to reach the decision?

A. There was no real time limit to the making of the decision—no one moment when the decision could be said to have been made.

Selecting new products

Q. How was the selection of new products made? Were outside consultants and market survey used?

A. We had to rely on our knowledge of our own skills and equipment in selecting the products to be made. We did hire a consultant to make a market survey on the air conditioning business and he also tried to evaluate the air cycle refrigeration unit versus the freon type system.

It was the opinion that the former bore the most promise for the immediate future and that freon would come along later. This forecast has been pretty well borne out by events.

Although it was indicated by the consultant's survey that the market volume would be low (this was before Korea), we decided to go ahead with development of a 25-pound unit. This work was well under way when an opportunity arose to bid on the unit for the North American F-86D. Our bid was successful and we were in the air conditioning business.

Q. What was customer reaction to your new products?

A. There was mixed customer reaction when we approached our former propeller customers. Some gave us credit for ability to perform on the new products as well as we had on propellers; others were very skeptical and even reluctant to take a chance on us compared to AiResearch Div. of Garrett Corp. and Stratos Div. of Fairchild, the two established companies in the air conditioning field.

Q. What was the state of your business at the time of the diversification decision?

A. At the time our decision was made we had about 2,000 employes and a total engineering, manufacturing and office establishment of 350,000 square feet, compared with our 10,000 personnel and 1,000,000 square feet of space at the height of World War II.

Today we have more than 11,500 employes and our square footage is in the vicinity of 1,750,000 square feet.

Electronic controls tested

Q. How was the necessary know-how obtained for your new product ventures?

A. We picked up our product know-how in several ways. In the fuel control field we had the help of Frank Offner, an electronic specialist with whom we had been working on electronic propeller controls since 1945.

Offner conceived the idea of adapting electronics to fuel controls and worked initially with Thompson Products Co. Due to our close association with electronic propeller controls, he then suggested that we enter the business and we took over the Thompson-Offner development.

At that time, we thought we knew enough about the subject to tag electronics as the right approach for controlling jet engines because of the inherent flexibility and high-speed reaction of electronic equipment. At first we could not sell other manufacturers on our fuel control capability, but we finally interested Pratt & Whitney Aircraft Div. (also UAC) in trying an electronic control on one of its early J57 engines.

This occurred after a successful demonstration on a P&W J48 turbojet engine.

Pratt & Whitney liked the electronic control, designated the JFC-3, and we built about 500 of them.

Despite this early success, tube troubles and other characteristics of the commercial electronics of that day strengthened the conviction of some at P&WA and among the military that electronics were not dependable enough for such a vital function as controlling an engine.

One of the major problems, which seemed insurmountable at the time, involved the damage to electronic parts caused by engine noise. Because of this, we started the development of a hydromechanical control, the JFC-4, with the help of P&WA. This has benefited from considerable running experience at P&WA.

As the result of the JFC-4's satisfactory testing, P&WA decided to go ahead with hydromechanical controls developed by both Bendix and Hamilton Standard as dual sources for the J57 engine. Our JFC-12 fuel control was then followed by a very successful hydromechanical control for the Curtiss-Wright T49; by the JFC-19 for the Orenda; the JFC-25 for the P&W J75; the JFC-26 for General Electric's T58; the JFC-27 and 28 for GE's J79 engine, and smaller controls for the Avco T55, the Fairchild J83, the Continental J69 and the GE T64.

Q. What led to your decision to enter the starter field?

A. We moved into the starter field because it was a natural extension of the background and skills we had developed in turbines for air conditioning systems, coupled with the gear experience for which our propeller background had well fitted us. A bid against an Air Force invitation led us into the pneumatic starter field, and we later began to work on combustion starters of the monopropellant, cartridge and fuel-air mixture type.

We soon decided that the cartridge-type starter, like electrical units, was getting too big for logistical purposes.

We therefore took a license with Plessy of England to build its propyl nitrate (liquid mono-propellant) starter, only to run into the logistics problem again. The military did not want the further complication which this approach necessitated in the fuel picture.

Use of our fuel-air starter on the Boeing 707 prototype, the Boeing KC-135 tanker, and the Convair F-102 and F-106 gives us assurance that we are on the right track with this development.

Set-backs and success

Q. Why did you go into the pump business?

A. The hydraulic pump involves us because we were interested in the development of a high-speed variable displacement pump by the Farmingdale Corp., which had made some progress in this field. We heard at the same time that the Navy wanted high-speed drives for its future engines. No pumps capable of such speeds were on the market. This made the situation appear quite promising, so we took over Farmingdale's design and know-how.

But we encountered a set-back when the Air Force did not go to high-speed drives and the Navy changed its mind.

As a result, the market for high-speed pumps—until very recently—became non-existent. With no market, we had to re-design the pump to make it competitive at the lower speeds.

Since that time we have kept the development of both types—low and high speed—moving ahead. We think the low speed pump we are making for the Convair B-58 is the most advanced in the field. This is the V-865.

We think it is the first hydraulic pump capable of operating at high temperatures with the type of fluid specified for the system. Development of this and other new items is centered in our St. Petersburg, Fla., engineering facility.

Q. Do you anticipate entering the electronics field?

A. The increasing dependance of the modern airplane upon electronics has found us, while not among the pioneers in the field, at least in the running with some practical background, skills, staff and established facilities.

Electronics dept. set up

Surveying the possibilities in electronics, we found we could draw upon our capability and experience in fuel controls, propeller controls, synchrophasers and air conditioning temperature controls. We therefore established an electronics department last year, and this year placed it on a virtually autonomous basis with the assigned purpose of soliciting business from other customers besides Hamilton Standard.

As a result of our early experience with commercially-made electronic units, which proved their unsuitability for the rigors and stresses of aviation installations, we were among the first to engineer circuits and controls from a mechanical standpoint.

To improve service and reliability, we pioneered in the concept of using potting compounds to protect whole circuits and we are well advanced in printed circuits, transistors and the rest of the basic stuff of which electronics is made.

The electronics department is currently accounting for two to three per cent of our total business, and we expect this percentage to grow. In the meantime, we have not given up the idea of electronics for fuel controls due to the inherent flexibility of the electronic system.

Q. What engineering, organizational and other problems did you encounter in your diversification program?

A. The basic backgrounds and skills acquired in 37 years of propeller business did not permit us to take on the new products without problems. We had to learn skills which were nonexistent or dormant. The fuel control, for example, is built like a watch. New materials and new processes had to be developed to meet temperature problems with starters, which had reached the borderline of the aluminum alloys then known.

Similarly, the organization as a whole had to grow. We had to learn to inspect these new products, and we really didn't know what to look for. Performance testing of these new products is far more rigorous than that required for propellers.

Big organizing job

Our testing requirements for air conditioning and starter systems set up a need for an enormous amount of compressed air and machinery. We probably have three million dollars invested in compressed air equipment alone.

We had to have special test cells in which to run jet engines, and other outside facilities for testing fuel controls and starters, both subject to explosion and fire control problems.

We have had to do a real organizing job in order to manage properly a concern that has grown tremendously in size, complexity, number of products, variety of customers and range of service problems. Increasing emphasis, it appears, must be placed on the individual product so that the various product lines receive the proper managerial attention. The requirement for more departmental specialization has been created by the tremendous increase in numbers and variety of shipments each month.

As we go forward, it appears that there will be a tendency to increase this specialization on the product to the point where virtually autonomous departments are set up by product. The fuel control, with its own building, and the electronics department are examples of this trend.

The disadvantage, of course, and this is one that disturbs us particularly, is the possibility that this product specialization will threaten the opportunities available to our people as a result of this growth. Selection of the right people for the job, regardless of departmental function or length of service, is the only way to recognize individual abilities. For this reason, departmentalization by product is being accomplished no more than is absolutely necessary.

Q. How do you feel about the weapon systems concept used by the military services for development of new hardware?

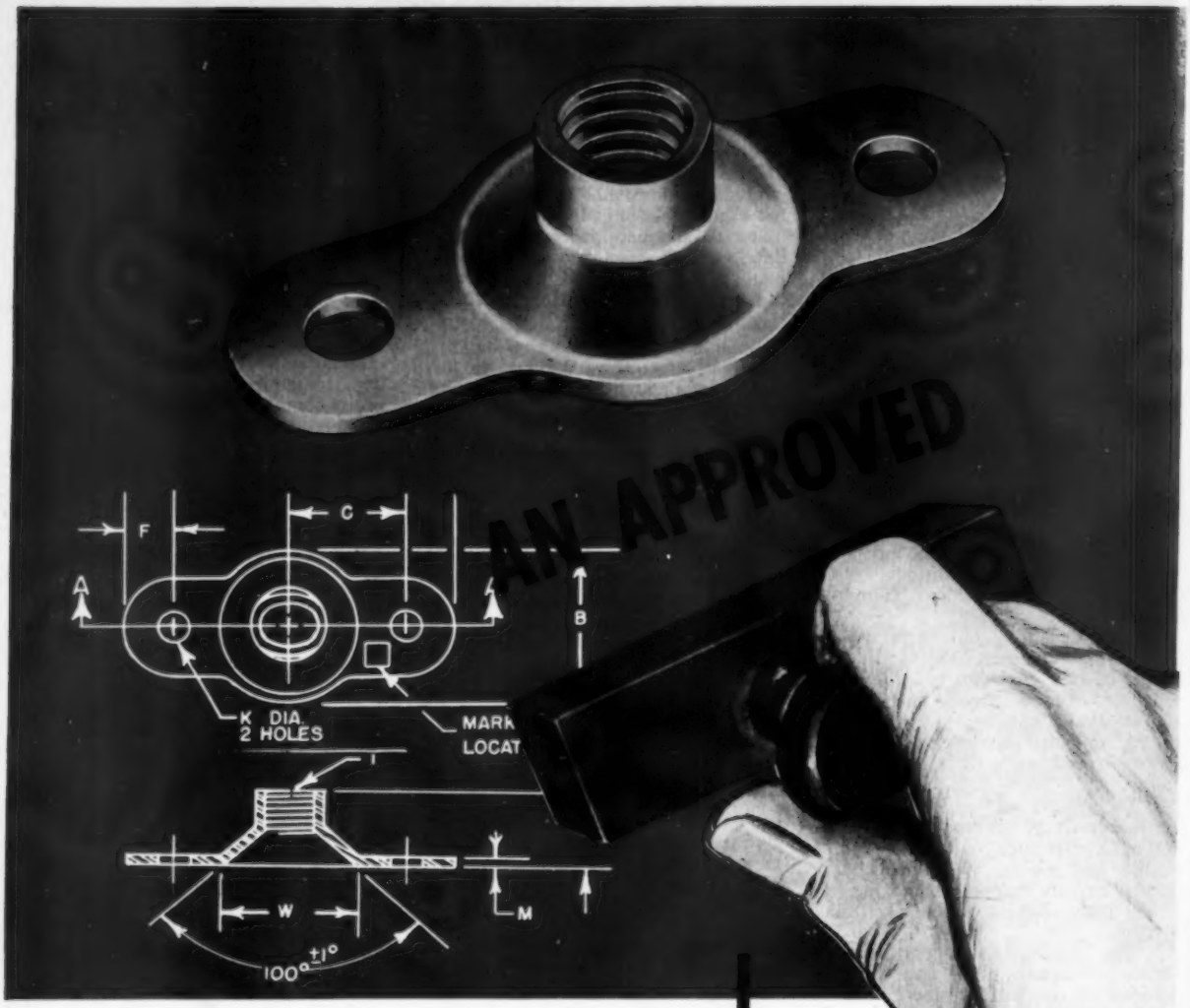
A. We are satisfied with the weapon systems concept as it relates to our present line of products. It has meant no real change for us. We may be affected in propellers, however, because the Navy is starting to tell airframe manufacturers to select propellers on their own.

Complete missile systems next

As for electronics, we have found there is little possibility of doing a major part of the electronics business on a new missile unless we hold the systems contract. We hope ultimately to take on complete missile systems because we feel this is the only way we can get important work in this field.

But eventually we believe the missile makers will come around to the approach we use in our own business. We buy our heat exchangers and ball bearings—we don't make them. We think the missile people will finally come around to this approach, and the fellow with the best guidance system will get the business.

MAIN PLANT of Hamilton Standard Division of United Aircraft Corp. is located at Windsor Locks, Conn., and totals 1,500,000 square feet. Main production facility was completed in 1952; lighter colored addition at the rear will be dedicated Oct. 29. Hamilton Standard will develop, produce and test fuel control sysems in new building and continue to manufacture propellers, air conditioning equipment, pumps and starters in older building.



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SOLUTIONS TO AIRCRAFT FASTENING PROBLEMS, SINCE 1942

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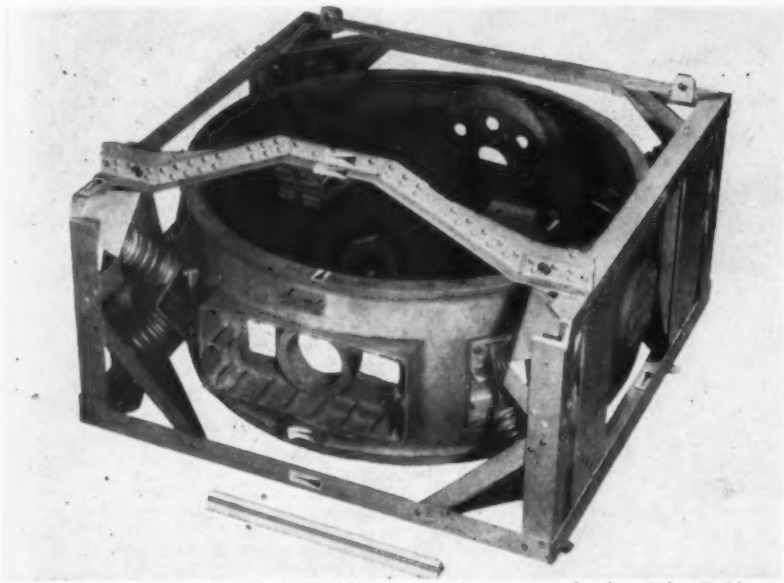
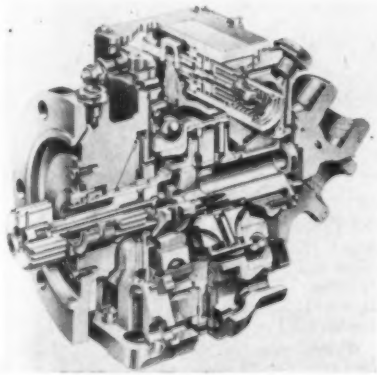
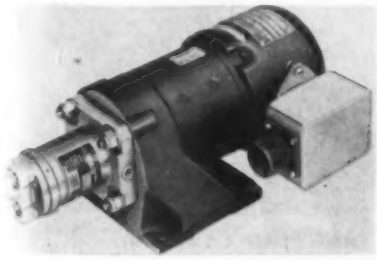
Shockmount for Regulus II



ALL-METAL, center-of-gravity, all-altitude mounting system developed by Robinson Aviation, Inc. for inertial navigator stable platform in Chance Vought Regulus II missile. Mass mock-up in photo simulates 360 lbs. of electronic equipment.



HYDRAULIC PUMP
Mfr.: Hamilton Standard Div. United Aircraft Corp.
Model: V-300
Ratings: 24.0 gpm
Remarks: For operation for 400°F with silicate fluids, 10,000 rpm.



MINIATURE PISTON MOTOR PUMP
Mfr.: Vickers, Inc.
Model: AA19054
Size: 9 15/16 in. long
Weight: 1.0 lb. (pump)
7.0 lbs. (motor)
Remarks: Delivers 0.84 gpm at 7,400 rpm and 1,000 psi. Starting torque less than 10 per cent over max. running. Motor is 28 vdc rated at 0.84 hp.

OXYGEN REGULATOR
Mfr.: Scott Aviation Corp.
Model: 10260
Size: 2¼" x 3-13/16" x 2¾"
Weight: 22 oz.
Ratings: inlet 2,000 psi, outlet 75 psi
Remarks: Pressure-reducing regulator for jet transports.

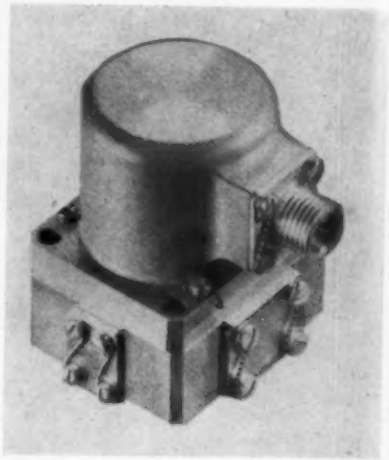
ELECTROPNEUMATIC VALVE
Mfr.: Barber-Colman Co.

Model: DYLZ
Size: 3.5 in. x 1.75 in. x 3.8 in.
Weight: about 0.7 lbs.
Ratings: .05 lbs./min. leakage at 300 psig, 300°F.
Remarks: ½-inch valve for duct temp. range up to 900°F.

LIQUID OXYGEN CONVERTER
Mfr.: The Aro Equipment Corp.
Model: 21071
Size: Spec. MIL-C25781
Weight: 17.4 lbs.
Ratings: for 70 psig systems
Remarks: Used for aircraft breathing system on TF-102A and F-106.

EJECTOR BOMB RACK
Mfr.: McLean Development Laboratories, Inc.
Size: 23.5" x 7.125" x 2.5"

Weight: 18.5 lbs.
Ratings: 1,450 lb. store, 14" suspension only.
Remarks: Fighter or attack aircraft for external store carriage.



SERVO VALVE
Mfr.: AiResearch Mfg. Co., Div. The Garrett Corp.
Weight: 1.25 lbs.
Ratings: 10 ma input; opn. pressure 200-4,000 psi; 0.12 to 5 gpm.
Remarks: Control system time dwell servo valve.

BY-PASS VALVE
Mfr.: M. C. Mfg. Co.
Size: 6.6" x 1.92" x 2.03"
Weight: 1.75 lbs.
Ratings: 2.5 gpm, 3,000 psi
Remarks: For hydraulic systems in F-102, F-106.

VANE PUMP CARTRIDGE
Mfr.: Vickers, Inc.
Weight: 2.5 oz.
Ratings: Delivers 1.04 gpm at 1,000 psi

SPECIFICATIONS OF TYPICAL AIRESEARCH COOLING PACKAGE

Air Flow	60 CFM
Fan Air Inlet Pressure	18 PSIA
Fan Pressure Rise	1.2 inches water
Heat Exchanger Pressure Drop	1.0 inches water
Liquid	Water Methanol (70% Methanol)
Liquid Flow	0.4 GPM
Heat Rejection*	300 Watts
Fan Power	30 Watts, 110 V., single phase, 400 cycle
Package envelope dimensions	7 x 6 x 3 inches
Package wet weight	2.5 lbs.

*Assumes Class A (85°C.) electronic components, liquid inlet temperature to heat exchanger, 55°C. Includes heat from fan motor.

This high performance AiResearch package cools sealed and pressurized electronic equipment. The fan circulates air through the liquid cooled heat exchanger and over electronic components in a hermetically sealed module. Air cooled units are also available. Fan and heat exchanger are designed, built and packaged by AiResearch for matched performance. Package size is tailored to your individual cooling requirements.

The Garrett Corporation, through its AiResearch Manufacturing divisions, is an industry leader in components and cooling systems for aircraft, missiles and nuclear applications. This wide experience is now being offered to the electronics industry to provide a cooling package to meet any cooling requirement. Send us details of your problem or contact the nearest Airsupply or Aero Engineering office for further information.

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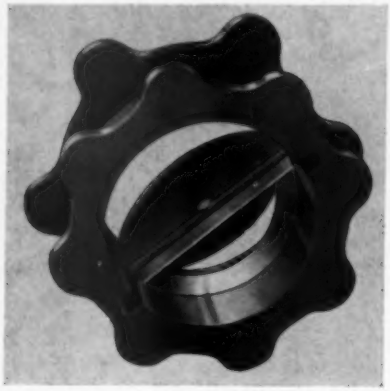
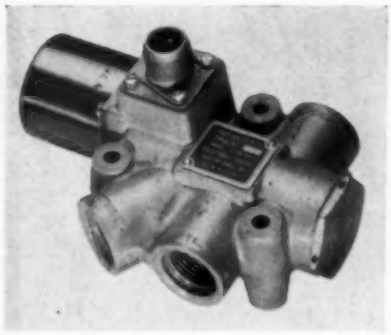
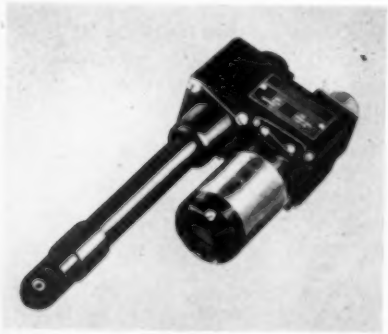
and 10,000 rpm.
Remarks: For use on small radar drives, electronic cooling, fuel pumps, missile skin cooling, pressure lubrication.



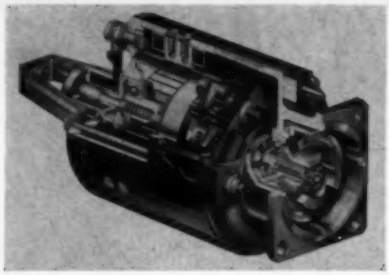
PNEUMATIC CHECK VALVE
Mfr.: Barber-Colman Co.
Model: DYLZ
Size: 1.5 in. x 3.72 in. x 3.72 in.
Weight: 0.95 lbs.
Ratings: .05 lb/min. maximum leakage at 200 psig, 700°F.
Remarks: 2½ in. dia. check valve



SOLENOID VALVE
Mfr.: Valcor Engineering Corp.
Size: 2.6" x 2.8" x 4.9"
Weight: 1.6 lbs.
Ratings: 3-way, 1,500 psi.
Remarks: For fuel hydraulic, pneumatic systems.



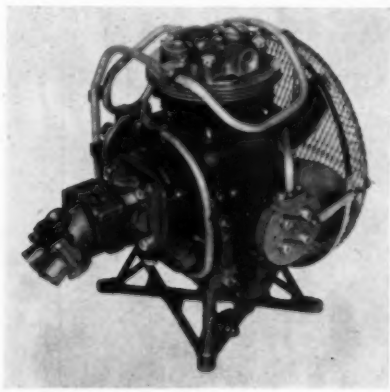
LINEAR ACTUATOR
Mfr.: Airborne Accessories Corp.
Model: 1080
Size: 1.68" x 3.35"
Weight: 1.75 lbs.
Ratings: 350 to 3,500 lbs., depending on unit
Remarks: Catalog available.



JET STARTER
Mfr.: Jack & Heintz
Model: 20069-002
Size: 11.05" x 4.875" dia.
Weight: 15.7 lbs.
Ratings: 25 lb.-ft. break-away torque; 14 ft. slipping torque
Remarks: For turbine engines of 1,000 hp.

COOLING PACKAGE
Mfr.: AiResearch Mfg. Co., Div. The Garrett Corp.
Size: 7" x 6" x 3"
Weight: 2.5 lbs.
Ratings: 60 cfm airflow; provides 300W heat rejection.
Remarks: For electronic cooling.

PILOT'S THROTTLE QUADRANT
Mfr.: Reid Metal Products Co.
Model: 8700
Remarks: For Convair F-106. Typical of special controls produced by Reid, which include irreversible bellcranks for North American F-107, drag spoiler control lever for Boeing 707 and KC-135, and remote slave irreversible throttle control for Lockheed F-104.



AIR COMPRESSOR
Mfr.: M.C. Mfg. Co.
Model: MC2004-20
Size: 11.12" x 9" x 9.98"
Weight: 13.95 lbs.
Ratings: S.L. inlet capacity 2SCFM at 3,000 psi.
Remarks: For McDonnell F4H.

HYDRAULIC ACTUATOR
Mfr.: Houdaille Industries, Inc., Buffalo Hydraulics Div.
Size: 2¾" dia. x 3¼"
Weight: 3 lbs.
Ratings: 2,000 in lbs. torque at 3,000 psi.
Remarks: For missiles or aircraft; angular travels up to 190°.

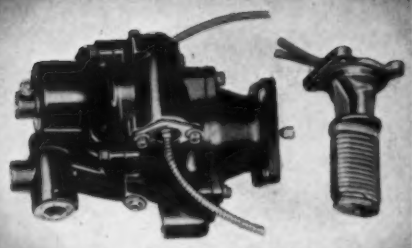
OXYGEN TRIGGER VALVE
Mfr.: Scott Aviation Corp.
Model: 10500
Size: 2½" x 4" x 4"
Weight: 15 oz.
Ratings: 2,000 psi
Remarks: For jet transports.

Other product sources

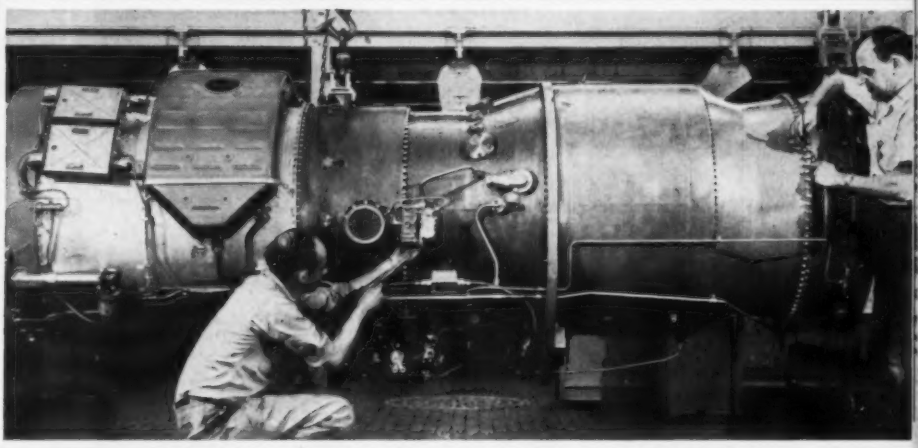
Brakes and wheels—B. F. Goodrich Aviation Products.
Coupling, breakaway—The Bruning Co.
Dehydration equipment—Robbins Aviation, replacement cartridge-type dehydration systems, mechanical filters, filter elements, valves for gases and liquids.
De-icers, metal-clad electrical—B. F. Goodrich Aviation Products.
Expulsion bladder—Joclin Mfg. Co., fluorlastic Teflon and Kel-F fuel cell expulsion unit for aircraft & missiles.
Fuel controls—Hamilton Standard Div., United Aircraft Corp., Models JFC7 to J5732 for jet engines, helicopter turbines, afterburners and exhaust nozzle areas.
Fuel controls—Holley Carburetor Co., model A11800 for J75 and A11400 for T34 engines.
Governor, compressor bleed—Holley Car-

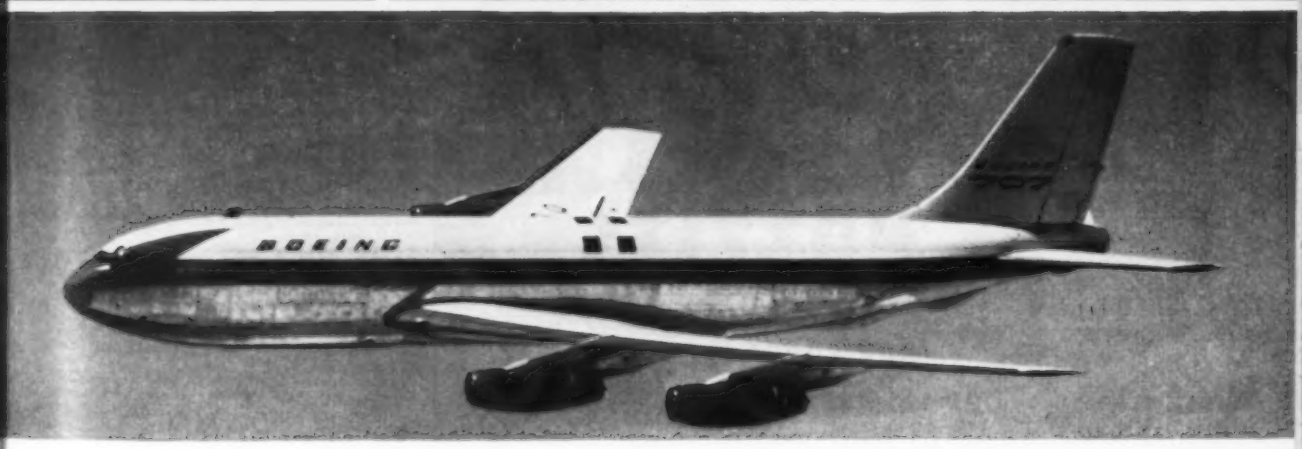
Holley engine controls selected for JT4 engines on America's first jet airliner

BLEED PISTON ACTUATOR



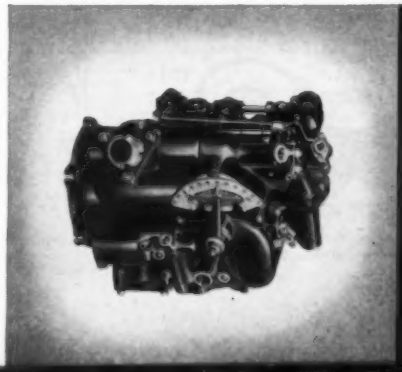
COMPRESSOR BLEED GOVERNOR





Powered by four JT4 Pratt & Whitney Aircraft engines, the Boeing 707-320 will carry 131 first class passengers from New York non-stop to the Continent in just over six hours! Each of these new engines, commercial counterparts to the J-75 which drives many of America's latest jet fighters, delivers up to 15,000 pounds of thrust. Ability to pack so much added power into a relatively small space is the result of designing engine components which will operate at higher efficiency, require less area and reduce over-all weight.

Holley Carburetor Company, working closely with Pratt & Whitney Aircraft engineers, carried out this exacting assignment on such vital engine components as: the compressor bleed governor, and the bleed governor actuator. For single and multi-engine military aircraft, the Holley main fuel control is a companion unit to the Holley governor and actuator.



For military applications, the Holley main fuel control (right) is a companion unit to the governor and actuator.

HOLLEY Carburetor Co.

11955 E. Nine Mile Road Warren, Michigan

Leader in the Design, Development and Manufacture of Aviation Fuel Metering Devices

buretor Co., model A4000 for J75.

Pneumatic actuator—Manning, Maxwell & Moore, Inc.; Model 141F14 for jet exhaust nozzle positioning.

Pressure switch—Manning, Maxwell & Moore, Inc.; Model 6576 for —65 to 650°F operation in Mach 3 aircraft.

Pump, propellant—General Electric Co., Aircraft Products Dept., handles 0.50 gpm normal propyl nitrate (at 260°F).

Solenoid valves, for ground support equipment etc.—Automatic Switch Co.

Suspension system—Lord Manufacturing Co., models LM-200 (front) and LM-200-SA9 (rear) mounting system developed for Allison 501 (T56) turboprop engine.

Turbine wheels (integral)—Schellens True Corp., blades milled from solid wheel on special purpose equipment; any machinable material, any blade shape, diameters to 12 in.

Directory of manufacturers

For additional information on products listed in this section, write to manufacturers at address below, attention Sales Manager. Give page number and refer to AMERICAN AVIATION ENGINEERS HANDBOOK of new products.

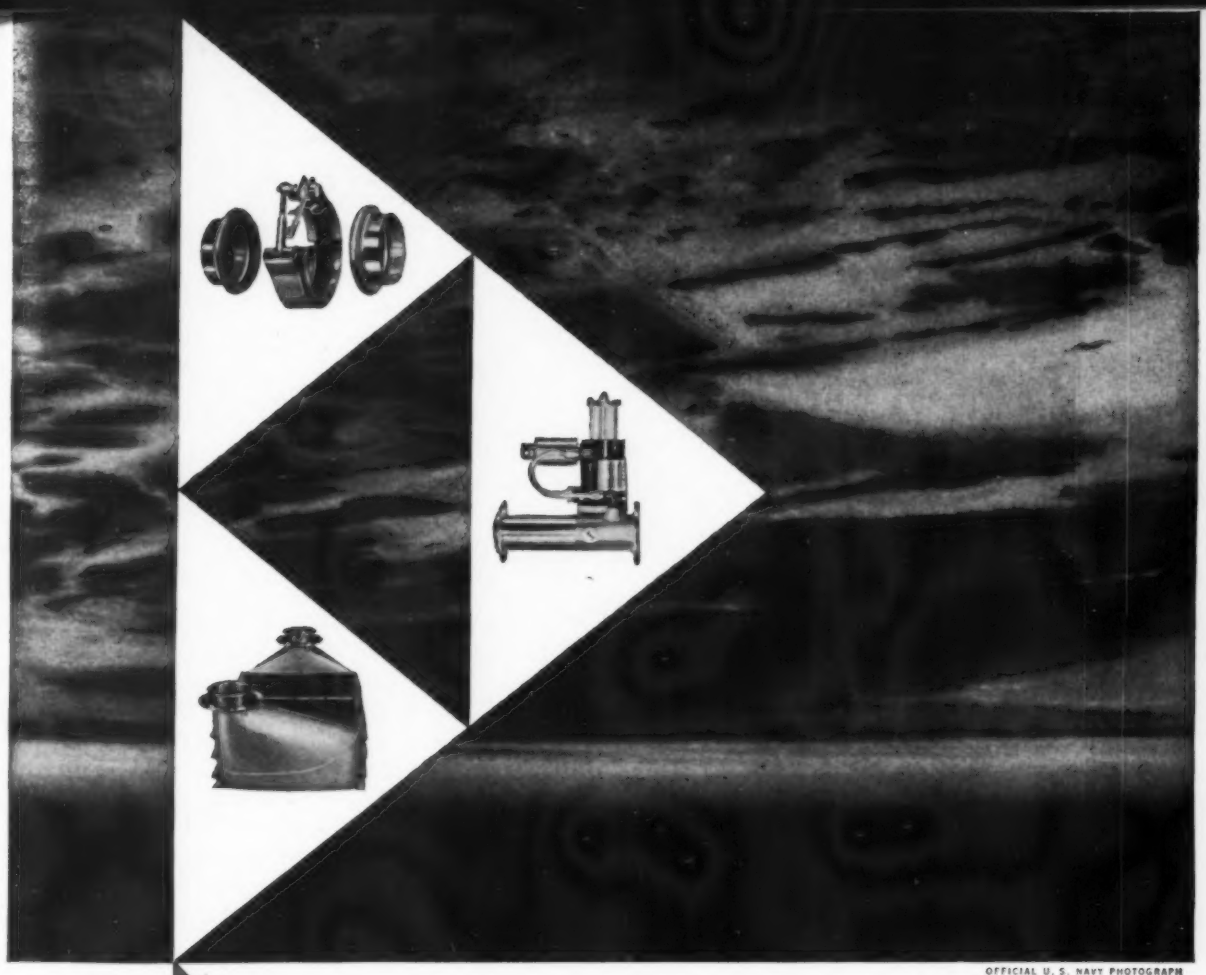
Airborne Accessories Corp., 1414 Chestnut Ave., Hillside 5, N.J.
AiResearch Mfg. Co., Div. of the Garrett Corp., Los Angeles 45, Calif.
AiResearch Mfg. Co. of Arizona, 402 So. 36th St., Phoenix, Ariz.
American Power Jet Co., 705 Grand Ave., Ridgefield, N.J.
Arkwin Industries, Inc., 648 Main St., Westbury, N.Y.
Aro Equipment Corp., The, Bryan, Ohio.
Automatic Switch Co., Florham Park, N.J.
Barber-Colman Co., 1437 Rock St., Rockford, Ill.
Bruning Co., The, P.O. Box 147, Lincoln 8, Neb.
Champion Spark Plug Co., 900 Upton Ave., Toledo 1, Ohio.
Conax Corp., 2300 Walden Ave., Buffalo 25, N.Y.
Cornelius Co., The, 550 39th Ave., N.E., Minneapolis 21, Minn.
Dunham-Bush, Inc., West Hartford, Conn.
General Electric Co., Aircraft Accessory Turbine Dept., Lynn, Mass.
General Electric Co., Aircraft Products Dept., Schenectady 5, N.Y.
Gray & Huleguard, Inc., 930 No. Hancock Ave., Los Angeles 46, Calif.
Holley Carburetor Co., 11955 E. Nine Mile Rd., Van Dyke, Mich.
Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
Houdaille Industries, Inc., Buffalo Hydraulics Div., 537 E. Delavan Ave., Buffalo 11, N.Y.
Hughes Tool Co., Aircraft Div., Florence Ave. and Teale St., Culver City, Calif.
Jack & Heintz, Inc., 17600 Broadway, Cleveland 1, Ohio.
Joclin Mfg. Co., Lufbury Ave., Wallingford, Conn.
Kilgore, Inc., Int'l. Flare Signal Div., Westerville, Ohio.
Lear, Inc., Lear-Romec Div., Abbe Rd., Elyria, Ohio
Lear, Inc., Grand Rapids Div., 110 Ionia Ave., N.W., Grand Rapids 2, Mich.
Lord Manufacturing Co., 1635 W. 12 St., Erie, Pa.
Lyndon Aircraft, Inc. sub. of Scovill Mfg. Co., 140 Clifford St., Newark 5, N.J.
Manning, Maxwell & Moore, Inc., Shelter Rock Lane, Danbury, Conn.
MC Manufacturing Co., Box 126, Lake Orion, Mich.
McLean Development Laboratories, Inc., Copiague, N.Y.
Pesco Products Div., Borg Warner Corp., 24700 No. Miles Rd., Bedford, Ohio.
Pioneer-Central Div., Bendix Aviation Corp., Davenport, Ia.
Pneu-Hydro Valve Corp., 344 Glenwood Ave., E. Orange, N.J.
Reid Metal Products, Inc., 2021 N. Lincoln St., Burbank, Calif.
Robinson Aviation, Inc., Teterboro Air Terminal, Teterboro, N.J.
Schellens True Corp., Ivoryton, Conn.
Scott Aviation Corp., 207 Erie St., Lancaster, N.Y.
Ucinite Co., The, Newtonville 60, Mass.
Valcor Engineering Corp., Carnegie Ave., Kenilworth, N.J.
Vickers, Inc., Administrative & Engineering Center, Detroit 32, Mich.

Product data – aircraft & engine accessories

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Absolute pressure regulator	Aro Equipment Corp.	12275-1	3¼" x 3⅜" x 2 49/64"	1.0		Pressurized electronic compartments.
Actuator, rotary	Lyndon Aircraft, Inc.	1501	8" x 3" x 1.82"	2	20 lb. in. torque @ .62 rpm. 28 vdc. max. static load 150 lb. in.	For aircraft flight-control system.
Air motor, cam piston	AiResearch Mfg. Co.	CM-710	13.3" x 3.1" x 4" dia.	22	Rated flow 18.5 output, 1,800 in. lbs. start torque	
" " "	" " "	CM-350	11.8" x 2.9" x 3.2" dia.	15.5	9.1 hp output; 890 in. lbs. start torque	
" " "	" " "	CM-160	9.7" x 3.2" x 2.5" dia.	7.5	4.2 hp output; 400 in. lbs. start torque	
Air valve	Barber-Colman Co.	DYLZ	2.13" x 3.15" x 2.95"	1.8	.10 lbs./min. max. internal leakage at 20 psig, 300°F	
Cable cutter, ballistic	Stanley Aviation Corp.		4" x 1" x 2 3/6"	0.45	Supplies force necessary to sever ⅛" steel cable, wires, rods or tubes	Cartridge-operated; for missile use.
Control box	Barber-Colman Co.	CYLZ	2.75" x 3.81" x 3.37"	1.1	For single-channel micropositioner or micropulse	Miniature, sealed.
Converter, liquid nitrogen	Aro Equipment Corp.	SKB 3631	Approx. 12.5" x 9.5" x 11"	Est. 19 empty	5 liters, N2, 10 L/M flow, pres. to 2,000 psig	For cooling infrared detectors; airborne for ground-mapping, anti-collision.
Converter, liquid helium	" " "	AP 57-204	Approx. 34" x 34"		Dewar to contain "black box" equip. 1.42 cu. ft.	Airborne and ground applications.
Converter, liquid oxygen	" " "	21061	Approx. 21" x 65"	Est. 1.35 empty	3.2 liters—70 psi system	For capsule ejection aircraft (bail-out breathing).
" "	" " "	21067		Approx. 30 empty	20 liter	For pressure energy source missile application.
Converter, liquid nitrogen	" " "	SKD 3639			Approx. 27.9 liters	For aircraft fuel-inerting & energy system.
Converter, liquid oxygen	Aro Equipment Corp.	21073	MIL-C-25777	17.5 empty	70 psig system	Aircraft breathing system, F105B.
Coupling, jettison tank	The Bruning Co.	5610-100	3" x 3" x 3½"	.8	42 GPM	For Convair F-106 fuel system.
Damper, hydraulic	Gray & Huleguard, Inc.	393	8.2" x 2.9" x 5.5"	6	Max. torque 1 rod./sec. 400 in. lbs.	For North American FJ-4 experimental.
Ejector, bomb rack	McLean Development Laboratories, Inc.	78 or Aero 11A	28.8" x 2.25" x 6.25" dia.	29.8	5,500 lb. store 30" suspension only	Aircraft, fighter or attack, internal or external.
" "	" "	80 or Aero 66A	23.5" x 2½" x 7.125" dia.	18.5	1450 lb. store 14" suspension only	Aircraft, fighter or attack, for external store carriage.
" "	" "	61 or Aero 22A	81.3" x 3.0" x 9.5" dia.	110	1,450 lb. store 14" or 30" suspension	
Explosive latchpins	Conax Corp.	LP-1	2 31/32" x 2" x 1"	7.5 oz.		99.96% plus, reliability; ±.002 second opn.
Explosive valve	" "	SEV-16	1.875" x 1.5" x ⅞"	6 oz.	5,000 psi	Zero leakage; normally closed or normally open.
Explosive valve	" "	SEV-22	2 7/16" x .725 dia.	2.5 oz.	For operation to 300°F	Zero leakage for missiles and aircraft.
Evaporator	Dunham-Bush, Inc.	F-12	6½" x 3½" x 5½"	2.3	5,700 btu/hr.	All aluminum tubular outer fin and inner fin.
Fans-axial flow	Pesco Products Div., Borg-Warner Corp.	080140-010	14" x 10"	17	4,650 cfm @ 7.8" w.g.	Helicopter oil cooling.
" " "	" " "	185079-010	7.9" x 7¼"	13.75	850 cfm @ 16.0" w.g.	Compartment cooling.
Flow restrictor-dual	Arkwin Industries, Inc.	54-04	4.0" x 1.0" dia.	0.12	60 psi.	
Fuel actuators	Arkwin Industries, Inc.	72-08	6.1" x 2.4"	11.8 oz.	750 psi.	
Heat exchanger (air-to-air)	Dunham-Bush, Inc.		4¼" x 2¼" x 3¾"	1	1,500 btu/hr.	All aluminum tubular outer fin and inner fin.
(oil-to-air)	" " "		15½" x 3⅝" x 6¼"	6	7,500 btu/hr.	Includes extension for picking up air duct work.
(ammonia-to-air)	" " "		5" x 5" x 5"	3.5	20,000 btu/hr.	All stainless steel. Tubular construction with outer and inner fins.
Heat exchanger, airborne electronic	Lear Romec Div., Lear, Inc.	RR 20090	15⅜" x 22⅞" x 10¾"	50	6,000w heat dissipation maintains max. liquid outlet temp. of 180°F. S.L. to 20,000 ft.	Dual circuit; for airborne electronic equipment.
Hydraulic power pack	Pesco Products Div., Borg-Warner Corp.	113260	16" x 12" x 8"	30	2 gpm @ 2,000 psi.	Missile.
Hydraulic pressure reducer	Arkwin Industries, Inc.	62-27	5.25" x 8.12"	0.5	3,000 psi.	
Hydraulic pumps	Hamilton Standard Div., United Aircraft Corp.	V-85			8.5 gpm.	Variable delivery, operate to 400°F. with silicate, fluids at 10,000 rpm.
" " "	" " "	V-120			12.5 gpm.	" " "
" " "	" " "	V-190			19.0 gpm.	" " "
" " "	" " "	V-540			20.1 gpm.	Variable delivery operation to 400°F., 3,750 rpm.
" " "	" " "	V-865			32.5 gpm.	" " "
Landing flare	Kilgore, Inc.	E102F	16⅞" x 7" x 3½"	30 oz.	75,000 candlepower	Helicopter flare.
" "	" "	E15F3	17½" x 12" x 4"	4 lb. 5 oz.	110,000 candlepower	For aircraft up to 3,500 lbs. gross.
" "	" "	SAS	25½" x 4½" dia.	18	300,000 candlepower	For aircraft of any gross weight.
Linear actuator	Barber-Colman Co.	JYLC	9" x 3.47" x 5.69"	4.31	Max. axial load 150 lbs.	Double jackscrew.
Microgland	Conax Corp.		21/32" x 11/32" hex.		.005 microns to 5,000 psi.	For sealing tubes from 1/16" to 3/32" dia.

Product data – aircraft & engine accessories *(Continued)*

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Midget thermocouple	Conax Corp.		2½" x ½" hex.		For pressures from .005 microns to 5,000 psi.	Smallest thermocouple gland available at rating.
Missile power unit	AiResearch Mfg. Co., The Garrett Corp.		6.74" x 6.14" dia.	9.5	650 watt output at 5,000 cycles, 115 V single phase 35 watts. 400 cycle single phase 0.6 gpm at 2,000 per hyd. press.	Duration 27 secs.
Motor, electric	Pesco Products Div., Borg-Warner Corp.	223536	7" x 4" dia.	12.5	28 V dc 2.6 hp 7950 rpm	Missile.
Motors, hydraulic 3000 psi	Pesco Products, Div. Borg-Warner Corp.	013386	6½" x 4" dia.	6	40 hp @ 6,000 rpm	Aircraft or missile.
Motorpump, oil-cooled	Vickers, Inc.		20" x 4" dia.	31.25	12 hp package, delivers 8 gpm at 2,250 psi, reducing to 6 gpm at 2,950 and zero at 3,000 psi.	92% efficiency of Vickers pump, bringing overall motorpump efficiency to 75%.
Oxygen breathing unit	Scott Aviation Corp.	8100A2		65	2,000 psi air	Safety breathing unit for missile fuel handling.
Oxygen control panel	Pioneer-Central Div., Bendix Aviation Corp.	GU-10	3" x 5¾" x 5⅝"	1.75	500 psi inlet pressure max.	Oxygen control and indicators for use with survival kits.
Oxygen kit, survival	" " "	29500	6½" x 16" x 20"	25	50-80 psi inlet	Survival system for high-altitude aircraft.
Oxygen mask assembly	" " "	GU-50	3⅞" x 3¾" dia.	4 oz.	Use with mask mounted regulators	Non-oriented universal mask, for use with mask-mounted regulators on high-altitude transports, etc.; silicone unit can be sterilized with steam or boiling water.
Oxygen regulator	" " "	29204	3¾" x 5¾" x 3"	2¾	Normal ceiling operation 32,000 ft. Inlet press. range 50 to 2,000 psi.	Panel lighting, automatic diluter demand regulator.
"	" " "	29200	1.5" x 1.6" dia.	1.5 oz.	System pressure 50 to 70 psi 100% oxygen at demand at all alt.	Mask-mounted demand type oxygen regulator for transport and executive aircraft. Use with Pioneer-Central GU-50 mask.
Oxygen regulator	" " "	29207	1⅝" x 1.6" dia.	1.6 oz.	100% oxygen @ 50-60 psi inlet press. fixed dilution @ 70-80 psi inlet	Mask-mounted demand regulator for transport and executive aircraft. Use with Pioneer-Central GU-50 type mask.
Oxygen regulator-continuous flow	Aro Equipment Corp.	17840	10" x 2⅞" x 5"	3.5	To supply 108 passenger outlets with 02 to 32,000 ft.	Passenger regulator for Lockheed Electra.
Oxygen regulator-automatic continuous flow	" " "	17970	5.87" x 2.87" x 4.62"		To supply 72 passenger outlets with O_2 to 40,000 ft	Passenger regulator for Boeing 707.
Oxygen regulator	Scott Aviation Corp.	11800		1¾ oz.	2,000 psi.	Miniature, 2-stage unit for pressurizing high-altitude aircraft equipment.
Oxygen unit	" " "	12200		12	5 hrs. at 20,000 ft., 2,000 psi.	For business aircraft.
Power plant, pneumatic	Lear-Romec Div., Lear, Inc.				Accelerates from zero to 100 rpm in .00004 secs. under 30 psig air press. against 20 lb. in. force	Available 0.66 to 30 hp; Pressures from 10 to 300 psig.
Power unit, auxiliary	General Electric Co.		4½" cyl (2) x 13"	35	1.5 to 10 hp provides 1,000 w 400 cpi, 115 V single phase; hyd. pump fitted to alternator shaft produces 4.75 gpm at 2,200 psi.	Self-contained electrical and hydraulic auxiliary power unit for aircraft and missiles.
Pneumatic regulator	Hughes Tool Co.	1500	3⅜" x 2 1/16" x 4⅛"	1.09	Max. inlet pres. 4,150 psi regulated pres. 600 to 1,500 psi.	
"	" " "	PR0150	3" x 1 13/16" x 4¼"	1.09	Max. inlet press. 3,000 psi reg. pres. 50-200 psi.	High flow, low pressure valve.
Pneumatic relief valve	Pneu-Hydro Valve Corp.	400-L	⅝" hex. x 1¾"	½ oz.	Flow 4 SCFM operating press. 0-3500 psi.	Subminiature adaptable to hydraulics.
Pressure reducer miniature	" " "	300-J	⅞" dia. x 3¾" L	max. 0.25	Inlet press. 0-3,000 psi. Flow up to 40 SCFM	Supplied with built-in relief valve. Conforms to MIL-R-8572.
Pressure-sensor release	Pioneer-Central Div., Bendix Aviation Corp.	GU-12	3½" x 3" x 2½"	1 max.	For auto-release of parachute s.l. to 15,000 ft., 300 knots EAS and below.	For aircraft with stabilized ejection seats or capsules. Releases chute at predetermined EAS and altitude.
Pressure suit test console	Scott Aviation Corp.	SC-6	16¼" x 14⅛" x 9⅜"	40	40,000 to 65,000 ft. altitude range	For indoctrination and testing.
Pump-acid booster	Pesco Products Div.	143102	6" x 3" dia.	3 lb. 14 oz.	.2#/sec @ 15 psi.	Red-fuming nitric acid, missile use.
Pump, diaphragm pressurization	The Cornelius Co.	283	8" x 5" x 6"	6½	1,728 cu. in. at 25 p l discharge pressure; service rated from 2,000 to 60,000 ft.	Available with ac or dc explosion-proof motor. Kit or package includes pressure switch, relief valve, check valve, chemical drier, etc.
Pump-jet air	Lyndon Aircraft, Inc.	1302	9.31" x 7.5" x 8.75"	3	Pumps 60 cf to 1.5 psi in 3 to 4 secs. Uses 3000 psi compressed air	Emergency flotation gear.
Pump, dry air	Pesco Products Div., Borg-Warner Corp.	133117-020	11" x 3" x 3½"	9	7 cfm @ 1 psi.	Pressure suit cooling.
" " "	" " "	133218-010		2	30 cfm @ 12 psi.	Para-balloon inflation.
Pump-hydrogen peroxide	" " "	X043235	13½" x 9" dia.	23	80,000 pph @ 30 psi.	Rocket power.
Pump-variable volume, hydraulic	" " "	013276	10" x 5½" dia.	22.25	10 gpm @ 3,000 psi.	All aircraft.
Pump, high speed centrifugal	" " "	023078	11½" x 6½" dia.	14.8	20,000 rpm 100 gpm 715 psi.	Jet engine.
Pump, lube oil	" " "	013429	2⅛" d.a. x 2.7"	1.25	6 gpm @ 50 psi.	Engine—5 element.



OFFICIAL U. S. NAVY PHOTOGRAPH

three Janitrol answers to exciting new problems!

Janitrol couplings for bleed air ducts provide positive metal-to-metal seal, are easily installed in tight spots, stay pressure-tight after repeated disconnects —and in addition give lowest weight per coupling yet achieved.

Janitrol pneumatic valves and regulators bring new versatility, light weight and dependability to air distribution systems for tank pressurization, canopy seal, and other vital air-powered devices.

Janitrol Platular® heat exchangers combine the efficiency of tubes, the strength of plates, and the simplicity of modular construction. They offer new compactness, high performance, and freedom of design in restricted spaces.

If your company is making major investments in jets and missiles for the future, Janitrol's resources can serve you well. They have carried a broad range of aircraft hardware out of the design stage into proven realities. Your Janitrol representative invites your inquiry . . . Janitrol Aircraft-Automotive Division, Surface Combustion Corporation, Columbus 16, Ohio.

Product data – aircraft & engine accessories *(Continued)*

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (Lb.)	Ratings	Remarks
Pump, refueling inflight	Pesco Products Div., Borg-Warner Corp.	023327	11½" x 12-18" dia.	16.6	4,200 rpm 200 gpm @ 110 psi.	Navy buddy tank refueling system.
Pump, water injection	" " "	043413	5⅛" x 9" dia.	14.25	6,400 rpm 80 gpm 350 psi.	Commercial jet.
Servo valve-hydraulic	" " "	013532	2½" x 2½" x 2"	10 oz.	2 to 4 gpm @ 3,000 psi.	Missile system.
Spark plug	Champion Spark Plug Co.	RHA29E	AND-10206			New 2-prong shell electrode plug designed to reduce ground fouling; approved for R3350 EA4, EA5 and EA6 engines.
Starters, jet	Hamilton Standard Div., United Aircraft Corp.	PS 150-2			139 16 A/O rpm	Pneumatic starter.
" "	" " "	PS 200-12			213 lb. ft./O rpm	Pneumatic starter.
" "	" " "	PS 300-6			77 hp peak	Pneumatic starter.
" "	" " "	PS 400-14			353 lb. ft./O rpm	Pneumatic starter.
" "	" " "	FAS 450-9			132 hp	Self-contained fuel air starter.
Starters, jet	Hamilton Standard Div., United Aircraft Corp.				163.2 hp.	Self-contained fuel air starter.
Valve, air/nitrogen	Automatic Switch Co.		⅜", 4-way		For 500 psi use	Bronze construction; explosion proof; poppet-type seats and discs.
Valve, air pressure control	Lyndon Aircraft, Inc.	1301	7.13" x 3.44" x 2.0"	2.25	Controls 290 psi air pressure or free ventilation; solenoid operated	Fuel tank ventilation.
Valve, bleeder	Arkwin Industries, Inc.	52-86	1.70" x .750" hex.	0.65 oz.	3,000 psi.	Missiles and aircraft
Valve, check	Pneu-Hydro Valve Corp.	500-M	⅛" dia. x 2¾"	1 oz.	Operating pres. 0-3,000 psi.	Designed for LOX, conforms to MIL-V 25514.
Valve, control	M.C. Manufacturing Co.	MC2648	5.76" x 1.63" x 2.06"	1.48	Capacity 74 scfm; operating pressure 0 to 1,000 psi.	Pneumatic, solenoid-operated; for rocket engine.
Valve, control	M.C. Manufacturing Co.	MC3632	4.19" x 3.9" x 1.94"	1.1	Capacity 210 scfm; operating pressure 200-3,800 psi.	Pneumatic, solenoid operated; for B-58.
Valve, inline relief	Arkwin Industries, Inc.	52-114	4" x .813 dia.	0.46	3,700 psi.	
Valve, liquid oxygen	Automatic Switch Co.		⅛", 2-way		For 3,000 psi service, —350°F.	Explosion-proof, stainless; for missile support and testing.
Valve, liquid oxygen	Pneu-Hydro Valve Corp.	100-B			Operating Pres: 0-400 psi.	Packaged liquid oxygen valving. Conforms to MIL-V-25169 & MIL-C-90828.
Valve, manual reset	Pneu-Hydro Valve Corp.	250-AE	2⅛" x 2⅛" x 3¼"	.75	3,000 psi, NO-NC, 18-30 VDC hydraulic-pneumatic	Momentary current required.
Valve, nitrogen/helium	Automatic Switch Co.		¼", 2-way		For 3,000 psi service, —350°F.	Explosion-proof, stainless; for missile support and testing.
Valve, oxygen cylinder	Scott Aviation Corp.	11200	3" high	25.5 oz.	2,000 psi.	Slow opening valve for jet transports.
Valve, pneumatic	Hughes Tool Co., Aircraft Div.	SV3000-4	3 7/16" x 2 1/16" x 4¼"	1.25	3,000 psi rated inlet pres. Continuous duty solenoid	Pilot-operated, 3-way valve.
Valve, pneumatic	Hughes Tool Co., Aircraft Div.	SV3000-2	3¼" x 2 1/16" x 4 1/16"	1.25	3,000 psi inlet continuous duty solenoid	Pilot operated, 2-way valve.
Valve, pressure reducing	M.C. Manufacturing Co.	MC3622-1	5.12" x 2.59" x 2.29"	1.23	Capacity 2,415 cgm, inlet 3,000 psi max. outlet range 200-400 psi.	Pneumatic, for Regulus II.
Valve, pressure reducing	M.C. Manufacturing Co.	MC3640	4.07" x 1.98" x 1.42"	.55	Capacity 144 scfm, inlet 3,000 psi max. outlet range 900-1,500 psi.	Pneumatic, for F-101.
Valve, pressure-vacuum	The Bruning Co.	12602B	3¾" x 1.625 D	.38	Variable	For Lockheed TV-2.
Valve, pressure-operated	Pneu-Hydro Valve Corp.	350-B	Dim. vary with tube size		0-3,000 psi operating pres. straight thru flow	Low to zero pressure drop. Models for ¼" to 2" tube sizes.
Valve, reducing (oxygen)	The Aro Equipment Corp.	17850	3.5" x 2⅞" x 4"	.75	To supply 3 crew regulators with O_2 to 32,000'	
Valve, regulating	Pneu-Hydro Valve Corp.	600-C	2½" x 2½" x 5"	.7	Inlet pres. 0-3,500 psi. Braking pres. 0-600 psi.	Output pressure adjust. Negligible hysterisis.
Valve, relief	M.C. Manufacturing Co.	MC1625	4.36" x .875" dia.	.16	Capacity 4 scfm, adjustment range 500-3,800 psi.	Pneumatic, missile nosecone control.
Valve, relief	American Power Jet Co.	47	2" x 2" x 4.875"	1.25	35-85 psi.—alternate ranges available	Vents liquified gases such as oxygen, hydrogen, helium and nitrogen at constant pressure settings.
Valve, solenoid	Valcor Engineering Corp.	V-3900	1.2" x 2.0" x 3.5"	.33	Normally closed 100 psi.	For fuel hydraulic or pneumatic systems.
" "	" " "	V-4700	1.5" x 2.1" x 2.5"	.44	Normally open 20 psi.	" " "
" "	" " "	V-200-12A	1.2" x 2.0" x 3.7"	.67	Normally closed 120 psi.	" " "
" "	" " "	V-21100	1.8" x 2.1" x 5.2"	1.5	Normally closed double coil 245 psi.	" " "
" "	Arkwin Industries, Inc.	57-10	2.07" x 1.125" x 3.5"	0.45	20-30 psi.	Pneumatic.
Valve, solenoid operated	Pneu-Hydro Valve Corp.	250-J	2⅛" x 2½" x 2½"	1.5	Operating pres. 0-3,000 psi NO-NC, 13-30vdc; ac available	Bubble-tight shut-off valve.
Valve, shutoff	M.C. Manufacturing Co.	MC2643	3.52" x 2.12" x 1.58"	.95	Capacity 13 scfm; operating pressure 200 psi.	Solenoid-operated for missile nose-cone control.
Valve, shutoff	M.C. Manufacturing Co.	MC3720	4.09" x 2" x 2.4"	1.1	Capacity 100 scfm, operating pres. 200 psi.	Pneumatic, missile nose-cone control.
Valve, 2-way & 3-way	Hughes Tool Co., Aircraft Div.	SV1500-2	3⅛" x 2 1/16" x 4 1/16"	1.15	3,000 psi rated inlet pres. continuous duty solenoid	Direct-acting, 2-way and 3-way valve.
Vibration, Isolator	The Ucinite Co.	Series 125500	1¼" x 1¼" x ⅜"	½ oz.	¼#, ½#, 1#, 2# & 3# ratings in No. 1 plate size	Diagonal spring equiflex used in aircraft and missiles.
Windshield temperature control	Barber-Colman Co.	CYLZ	5.26" x 4" x 2.50"	approx. 2.4	Constant 100°F temp.	Automatic control.

Fisher discusses with Donald W. Nyrop, NWA President, and Frank Judd, Vice President – Operations & Engineering, (L/R), their new DC-7C fleet, which uses Champions in world climatic extremes of 100° above to 20° below.

Another in a series on the care taken by leading airlines to maintain top flight efficiency—and why this care has led them to select **CHAMPION SPARK PLUGS.**

Noted aviation authority reports on

NORTHWEST Orient AIRLINES...

Airmanship along the Northwest Passage

Once there was just air. Man came. He built a ship, conquered air. Air . . . man . . . ship. Cast in the master mold of Northwest Orient Airlines experience, this triumvirate of basic, vital elements became *Airmanship.*

How does Northwest define the new element it fired to perfection in the fusion of these three basics?

Airmanship is the knowledge and skill in all things pertaining to the operation, maintenance, management and safety of air transportation and the achievement of the highest standards of public service.

Northwest has it. Northwest pioneered it, built a long-dreamed Northwest Passage with it—a passage to the Far East with a luxury and safety the men who sailed the St. Lawrence never envisioned possible in their wildest moments.

With these thoughts, I watched Northwest Airlines' president, Donald W. Nyrop, trace NWA's routes on his office map . . . from the concrete canyons of New York City over the Great Lakes and plains, across the piney pattern of Canada and tundras of Alaska, over the Pacific and into the far land of

by HERB FISHER
international aviation authority, veteran test pilot, author

Artist's drawing of new $18,000,000 NWA Main Office & Overhaul Base at Wold-Chamberlain Field, Minneapolis-St. Paul.

pagodas, lotus ponds and Buddhist shrines. Here is a new Northwest Passage carved from the skies by 31 years of superior NWA Airmanship over land and sea.

Two rented open-cockpit mail planes, three 3-passenger cabin monoplanes and a handful of dedicated employees triggered fusionable elements of NWA Airmanship in 1926.

NWA began exploring its Northwest Passage in 1933 by flying the first commercial plane over the Northern Rockies and into the Pacific Northwest. This Airmanship feat—previously termed next to impossible because of the vast terrain, tricky heights and blizzards—took six days. NWA trail blazers rammed their "tin goose" through furious snowstorms and hair-raising downdrafts, once dropping 1,800 feet down the backside of a peak near Stampede Pass. Lacking radio and weather reports in those days, they flew visually, inching through unknown mountain passes and skirting peaks, often at treetop level. They fought severe icing conditions and bucked runway snowdrifts. Attaining Seattle, they were soon awarded the *first northern transcontinental route* between Chicago and the West Coast.

In like spirit, NWA pushed on to Alaska . . . became the first airline to link Hawaii with the Pacific Northwest . . . then spanned half the globe in 1947 to terminate its Northwest Passage in the Orient. NWA pioneered the Great Circle route to Japan, Korea, Okinawa, Formosa, Hong Kong and Manila—and has just been cited by the National Safety Council for a perfect safety record: "For splendid achievement in maintaining Orient service for 10 years without a passenger fatality in scheduled airline operations."

During this decade, Northwest planes flew more than 68 million miles to and from Hawaii, Alaska and the Orient . . . crossed the Pacific to and from Japan 4,600 times on regularly scheduled flights . . . logged 1,380,600,000 passenger-miles.

New turbo-compound DC-7C's featuring "Imperial Service," a new concept in luxury, are now going into service on all Northwest's daily Orient runs.

With nuclear impact in the aviation industry then, NWA Airmanship mushroomed to its present stature—71 ultra-modern air transports flying 31,000,000 plane-miles and more than a billion passenger-miles annually . . . 5,651 skilled employees . . . a $30 million annual payroll . . . 20,000 route-miles serving 28 domestic cities plus stations abroad . . . a $76 million annual operating revenue . . . and more than a million and a half satisfied passengers.

Service reliability became a vital requisite for maintaining superior Airmanship. It is reflected today in Northwest's on-schedule precision, aircraft dependability, pilot efficiency, passenger comfort and safety. To assure both service and safety, Northwest operates only the finest in aircraft, the very latest in high-quality parts and equipment. Radar, for example, is one of many navigational devices contributing to NWA's optimum performance.

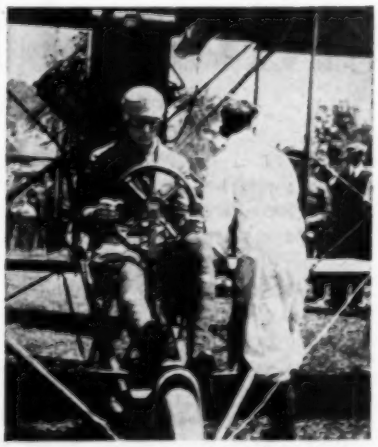
The pencil beam of Northwest's dual-scope X-band radar paints a sharp, clear picture of weather up to 150 miles ahead. It forewarns minute by minute, day or night, of turbulence, pointing the way to smooth, fast, safe flight.

Backbone of efficiency and reliability in NWA airline operations is maintenance, both line and overhaul. NWA operates maintenance facilities in Hong Kong, Manila, Tokyo, Seattle, Minneapolis, Chicago and New York to assure peak flight efficiency for its fleet of DC-7C's, Stratocruisers, DC-6B's, DC-4's and DC-3's.

When I visited the Northwest Overhaul Base at Holman Field in St. Paul, I saw 1,200 employees forging the quality of superior Airmanship into NWA fleet maintenance.

Airmanship discussed by (L/R) Fisher; L. E. Koerner, Ass't. Overhaul Director; R. H. Zinn, Overhaul Director.

C. G. Magnuson, Powerplant-Accessory Overhaul Supt., and J. A. Zechiel, Airframe-Component Overhaul Supt., (L/R), integrate duties.



July 4, 1917 – "I wasn't asleep, I was scared stiff," says Capt. Walter R. Bullock, NWA pilot who today flies Stratocruisers and epitomizes Airmanship with

Completing subzero flight on Champions (L/R): Capt. Burke Frees, Fisher, Capt. R. C. McLaughlin, Flight Engineer Richard Frye.

NWA's president, Don Nyrop, a former chairman of the Civil Aeronautics Board and CAA administrator, told me this: "All of us here are working together to further develop our company in the highest standards of service, safety and operational efficiency. With this objective, we constantly monitor our programs with regard to the procurement of airplane parts and accessories. Our standards require us to purchase only those products which give us the highest degree of schedule reliability."

As a long-time pilot and veteran member of the aviation fraternity in several capacities—and knowing full well the problems of the air transport industry—I can appreciate the pride Northwest has in Don Nyrop as its president. I've known him personally for many years. He's a young executive who knows firsthand the importance of airline service and safety. He has brought to the airline presidency both vigor and understanding—qualities as essential to over-all airline success as Airmanship is to its operation.

In this daily operation, Northwest runs the gamut of global climatic extremes. "Many of our long-range transports pass through the most varied temperatures existing in the world—all in one flight," said Paul Sanders, Director of Line Maintenance, which is responsible for day-to-day care of the fleet. "Any one of our new DC-7C's, for example, may leave the 100-degree heat of Manila and cruise through 20- to 30-below-zero temperatures as it passes over Alaska to its stateside destination."

This means maintenance technicians must give special attention to engine function each day as they combat over-all effects of high temperature and humidity on one hand and freezing rain and subzero temperatures on the other. Ignition systems in particular are of major concern in these operational extremes. And reliability of components such as Champion Spark Plugs is vital.

"Cold weather starting difficulties from spark plug sources are virtually nonexistent," Mr. Sanders said, "and at the other extreme, starting and operational difficulties from high moisture areas and subtropic climates are also nonexistent."

Northwest has used nothing but Champions—throughout the world and in all engines and equipment—for ten years.

"We've service-tested other spark plugs during this time." Sanders said, "but the plug we adopted as standard equipment always proved superior. We're using the Champion massive electrode type now."

Northwest's fleet goes to Holman Field for progressive overhaul on the average of once every 2,000 flying hours. Engines are completely torn down and reconditioned at intervals of five months or 1,300 to 1,700 hours.

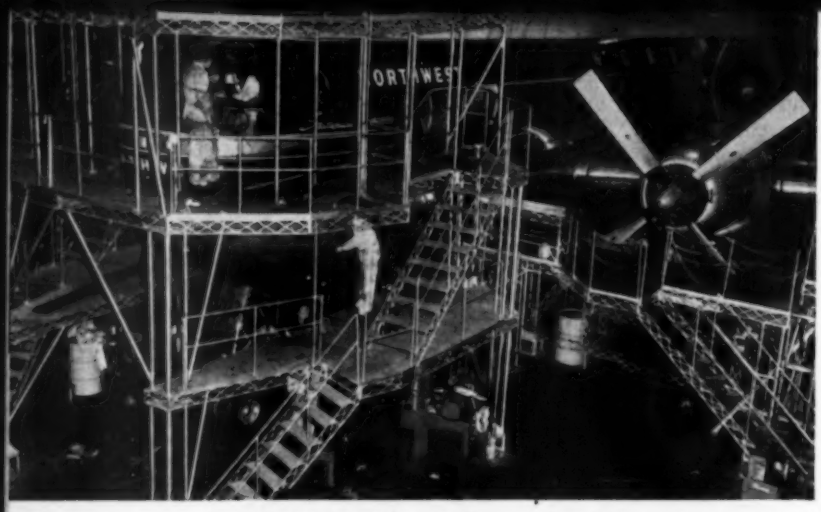
"Spark plugs are one of the chief performance factors in reliability of any engine," said Lou Koerner, senior NWA employee. "We feel that Champion can take pride in a prod-

Through blizzards and tricky heights, they rammed first commercial plane through Northern Rockies to Pacific Northwest. That NWA Airmanship feat opened "Northwest Passage." Famed crew of historic 1933 flight included aviatrix Amelia Earhart. Men (L/R): Capts. Joe Kimm, Hugh Rueschenberg, Mal Freeburg.

Mechanic Bud Morgan dubs first radar-equipped NWA Stratocruiser "Rudolph with the Radar Nose." Entire NWA pressurized fleet now carries Bendix dual-scope X-band radar.

Tom E. Cooper, Aircraft Engineering Supt., and Leonard P. Larson, Design & Performance Analysis Supt., (L/R), report: "We've used nothing but Champions for 10 years."

Superior Airmanship skills of Mechanics Norman C. Dinsmore, Hubert E. Gilbertson, David P. Vanarsdall and Clark F. Anderson go into NWA engine.



Special triple-deck scaffolding cages NWA Stratocruiser in overhaul. These $2,000,000 planes are among world's largest commercial airliners.

NWA Ford tri-motor that blazed "Northwest Passage" to Alaska's door.

Circus elephant flies 20th Century "Northwest Passage" to Alaska via NWA. Helpful stewardess is Miss Charmalee Prentice.

Discussing NWA service in Orient, (L/R): Paul H. Sanders, Line Maintenance & Ground Services Director; Fisher; Robert L. Clifford, Ignition Specialist & Ass't. Director; Carl H. Graf, Eastern Flight Operations Supt.

uct which has contributed so much to this complex business of operating modern airliners." Mr. Koerner has been with NWA 29 years and knows the meaning of service reliability.

Raleigh Zinn, NWA Overhaul Director, said: "To maintain our enviable airline record of reliability in all types of aircraft and engines, we must have products offering maximum reliability at lowest cost. In using Champions 100 per cent, we've considered initial cost, length of service, cost of spark plug overhaul and the number of overhauls feasible with that plug, plus its thoroughly tested performance reliability."

Perhaps the man closest to the actual mechanics of ignition is Carl G. Magnuson, Powerplant and Accessory Overhaul Superintendent. "A malfunctioning spark plug," he told me, "not only causes engine misfiring and consequent roughness, it also has a detrimental effect on other combustion chamber components. For this reason, let me tell you, we at Northwest are very critical in our choice of spark plugs and in our spark plug overhaul standards. For a decade now, we've found Champions the best in reliability—and second to none in economy."

Judicious economy is wisdom at work in any successful business. At Northwest it's a facet of superior Airmanship as it applies to Management *and* Maintenance.

"Our reconditioning standards are rigid," reported Robert J. Clifford, Assistant Director of Line Maintenance. "Spark plugs overhauled in our shop are of the highest quality." New spark plugs are operated about 360 engine-hours before reconditioning. The reconditioned Champions are returned for another 360 hours of good-as-new performance.

"Champion customer service is of the highest order in helping us solve new problems and in establishing economical operating practices," said Tom E. Cooper, Aircraft Engineering Superintendent. "Champion's effort put into their Annual Ignition Conferences has resulted in tremendous good—product improvement and airline-supplier understanding, for example."

Goodwin I. Luck, Powerplant Engineering Supervisor, summed up my findings at Northwest: "We want the most reliable, safest powerplants attainable in the industry today. That's why we go to all extremes to find the most reliable components for the heart of the powerplant—the ignition system. After reviewing every available spark plug in the industry, we have repeatedly come up with the same conclusion these past ten years: Champions afford us the most advantage."

Goodwin I. Luck, Powerplant Engineering Supt., and Ray Posz, top Ignition Engineer, (L/R), plan engine overhaul.

That advantage is reflected in NWA's transcontinental and trans-Pacific operational record.

And there is more to come with Northwest Airmanship as construction moves ahead on NWA's $18,000,000 headquarters at Wold-Chamberlain Field. This massive structure with 800,000 square feet of work space will house NWA's general offices, line maintenance shops and new overhaul base.

And millions of pleased passengers will continue flying the 20th Century's Northwest Passage to the Far East via the airline that superior Airmanship built—Northwest Orient.

by HERBERT O. FISHER

CHAMPION SPARK PLUG COMPANY • TOLEDO 1, OHIO

How Pesco speeded up its spare parts service

by William O'Donnell

WITH COMMERCIAL JET aircraft production picking up rapidly, many parts and accessory manufacturers which have been supporting military jet programs exclusively are finding their way into the commercial field for the first time.

And with this change, these companies face the new task of not only selling their products to commercial customers, but of holding them as a permanent market for the future. The change brings new problems of warranties, engineering service support and most important of all—spare parts support.

These newcomers to the civil aircraft market will do well to take a lesson from one of the "old-timers" in the field and benefit from a firm that learned the hard way how to keep commercial customers happy through an efficient method of supplying spare parts.

The company that can discuss this problem with authority is Pesco Products Div. of Borg-Warner Corp. Pesco produces hydraulic pumps, fuel pumps, vacuum equipment, electric motors and similar aircraft equipment both for government and commercial users.

Until 1953 Pesco maintained no inventory of parts. The company would make parts on order but this meant that the customer had to order well in advance to meet his requirements.

Service was too slow

"Consequently service was poor from the customer's standpoint," recalls Frank E. Caldwell, Pesco manager of airline stores. "It took about four months to supply a part under this system."

Pesco set out to find a way to keep the customers happy and at the same time not tie up too much of the company's money in inventory.

"We had been dealing with the airlines for some time and had records of what parts they were buying, in what quantities and how often. This gave us a pretty good idea of what parts to stock and how many," Caldwell said. "We decided to establish an inventory of some 5,000 basic units for the 'off-the-shelf' service."

The company allocated some $350,000 to set up the airlines stores supply.

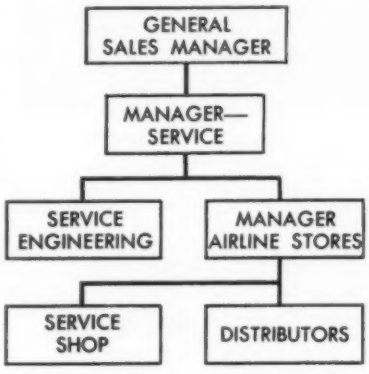
The situation between Pesco and its airline customers had reached a critical point before the stores system was established, according to industry observers. Some airlines would go so far as to request parts other than Pesco when placing orders with airframe manufacturers.

"It's quite a different story today," Caldwell said. "Daily, we receive reports of fine service from our spare parts organization and airlines are asking aircraft manufacturers to use our products when possible."

Pesco now supplies about 90% of the spare parts ordered by airlines on an off-the-shelf basis. Most of the other parts would be supplied within 30 to 60 days rather than the four months minimum required before 1953.

How stores are set up

Airline stores at Pesco are included in the organization of the service manager which, in turn, is a unit of



Here's how the airlines stores service is set up within the sales department at Pesco Products Div. Airlines stores manager reports to service manager who, in turn, reports to general sales manager.

the sales department under the general sales manager. The stores unit maintains the inventory and keeps all stock records. The service is only for airlines, since military customers and airframe manufacturers do not require inventories other than their own.

The paper work in Pesco's airlines stores plan is simple. When a purchase order is received, the purchase order number, parts numbers and quantities are transferred to a shop order. If the customer requests a date of delivery this is noted, otherwise Pesco notes what date it will be able to make the shipment. The shop order is sent to the inventory crib, where it is filled from the shelf, or to the shop, where parts are made. The shop order is then used as a packing sheet, bill of lading and invoice.

In addition to the airlines stores, Pesco recently contracted with a number of distributors to handle the company's field services, including replacement parts for all units in production and for complete units. The distributors are authorized to do business with the airlines and also to set up their own service facilities for Pesco products.

Pesco distributors include: Airwork Corp., W. J. Connell Co., Pacific Airmotive Corp., Southwest Airmotive Co., Standard Aircraft Equipment Co., General Aircraft Supply Co. and Minnesota Airmotive, Inc.

"We feel that the airlines stores and distributor services now provide our customers with improved parts deliveries and improved service contacts," Caldwell said.

Cooperating with airlines

Pesco is now working with airlines to set up the same services to handle jet equipment. Discussions with airline purchasing agents and project engineers and "good judgment" are being used as guides as to what and how many parts will be held in the jet inventory.

"To begin with, we will stock enough parts so that nobody will be embarrassed. As we get more jet experience we will be able to make adjustments," Caldwell said.

Pesco accessories will be used on five different jets. The Lockheed Electra will carry 32 Pesco pumps in addition to other parts; the Fairchild F-27 Friendship has two pumps; Douglas DC-8 32 units; Boeing 707 four pumps; and the Convair 880 one pump.

Among the aircraft now in service which carry Pesco products are Douglas DC-3, DC-4, DC-6, DC-6A, DC-6B, DC-7; Martin 202 and 404; Lockheed 049, 749, 1049, 1049C, 1049G; Convair 240, 340 and 440.

Although Pesco is an "old-timer" in the business of aircraft accessories, the company is relatively young in comparison with many of the nation's manufacturers. It was started in 1933 by three men who rented a small building in Cleveland, Ohio, and made a down payment on two drill presses, one lathe, one milling machine, one gear shaper, one assembly bench, one drawing table and a desk.

By 1935 there were seven employes. In 1939 a new company was formed and purchased the assets of the original firm. It was at this time that Pesco became part of Borg-Warner.

Today's Pesco plant covers 312,631 sq. ft. at Bedford, a suburban community located about 10 miles

southeast of Cleveland. The plant is well equipped with production, research and testing facilities and employs nearly 1,000 employes.

In development or preliminary design at Pesco are such products as pumps for propellants and special fuels, pumps for circulating liquid metal nuclear coolant, an electro-hydraulic nuclear control rod mechanism, electro-hydraulic servo transfer valves, air and gas turbine drives.

For aircraft of the future, Pesco engineers see pumps that will operate at fuel temperatures of 800°, pressures of 1,500 psi and flows of 600 gpm. Propellant pumps will provide capacities to 5,000 gpm, nuclear coolant pumps will handle 1,500 gpm.

Among recent additions to Pesco's research facilities is a high-temperature fuel laboratory, a high-temperature hydraulics laboratory and a propellant laboratory. Long-range plans call for an advanced propellant-nuclear coolant laboratory.

Liquid oxygen saves space in Douglas aircraft

Douglas Aircraft Co. is saving space and weight in A3D, A4D and F4D aircraft by using liquid oxygen for the crew personal oxygen systems.

Requiring less than half the space of conventional high-pressure bottles made of heavy steel, the new system operates at very low pressures and is but a fraction of the weight.

LIQUID OXYGEN SYSTEM, top left, replaces eight steel high-pressure bottles, results in savings of 121 lbs.

A single unit, weighing 55 lbs. when filled, replaces eight high-pressure oxygen cylinders weighing 176 lbs.

The liquid system consists of an insulated spherical tank for the liquid oxygen surrounded by a coil of uninsulated tubing which transforms the liquid into usable gaseous oxygen. It is then drawn by the pilot's respiratory action through a conventional system.

From Whittaker's Fuel Division:

3-inch plug-in valve that cuts service time by 90%

Whittaker's 3-inch plug-in valve is standard on all new Lockheed Model 1649A's. Because body and actuator can be removed without opening tank or disturbing tank and line seals, an estimated 90% of maintenance time is saved.

In the Lockheed Model 1649A, TWA Jetstream,* new Whittaker gate type plug-in valve reduces ground time and expense during valve inspection.

PERFORMANCE

SERVICE. Aromatic and jet fuels
MOUNTING. Mounting flange grooved for MS29513-252 and MS29513-149 "O" ring packings
PRESSURE. Rated operating pressure 15 PSIG Max.
TEMPERATURE.
Ambient, −65°F to +160°F
Fluid, −65°F to +135°F
TEST PROCEDURE NO. 116306
TIME. Operating at 26 volts and 70°F:
Open – 1 second
Close – 1 second

ELECTRICAL DATA

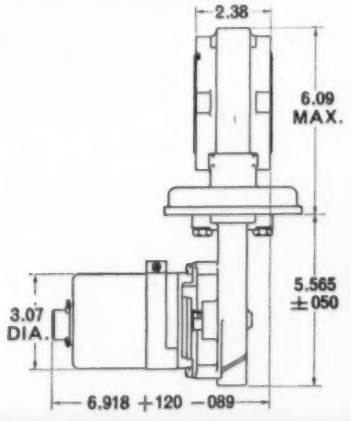
18 to 30 volt D.C. motor
AN3102E-16S-1P Receptacle provided
Pin "A" energized to open valve
Pin "B" energized to close valve
Pin "C" internally connected to Pin "D" in full open position
Pin "F" internally connected to Pin "G" in full closed position
Pin "E" common return for Pins "A" and "B"
Stall current 5.0 Amps. Max. @ 26 volts and 70°F

Installed in Lockheed's remarkable new Model 1649A, Whittaker's gate type plug-in valve permits removal, inspection and replacement without opening the tank or disturbing the tank or line seals.

This unit consists of an integral housing (permanently attached to fuel tank structure and plumbing), and valve body assembly including valve gate, gate seals, and body. This assembly is removable from the fixed housing.

The actuator in this valve can be replaced without leakage with the adjacent plumbing filled with fluid.

The AC or DC electric motor actuator, mounted on the valve body, can be removed individually or the actuator and body can be removed altogether.



*Jetstream is a service mark owned exclusively by TWA

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Name_____
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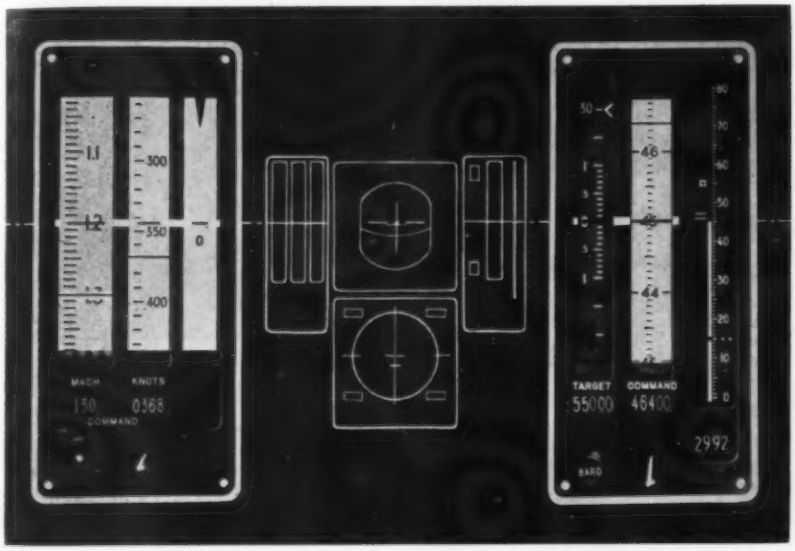
instrument panel for jets of future



NEW LOOK in cockpit instruments for future high-performance military and commercial jets is displayed in system developed by Eclipse-Pioneer Div., Bendix Aviation Corp., in conjunction with Wright Air Development Center. Panel at left shows aircraft operating at Mach 1.2 approaching a "command" speed of Mach 1.3 (white bordered black line). Immediately to right is indicated airspeed in knots (345) with command speed lined at 368 knots. Third bar shows angle of attack with symbols warning of approach to G limit and stall. Instruments at right indicate 30,000 fpm rate of climb (box at top of first scale), aircraft is at 45,000 ft. headed for command altitude of 46,400 ft. (center scale), and last at right displays gross altitude. This scale also shows a target altitude symbol (small square box at 55,000 ft.) and cabin altitude symbol (stripped bar at 15,000 ft.).

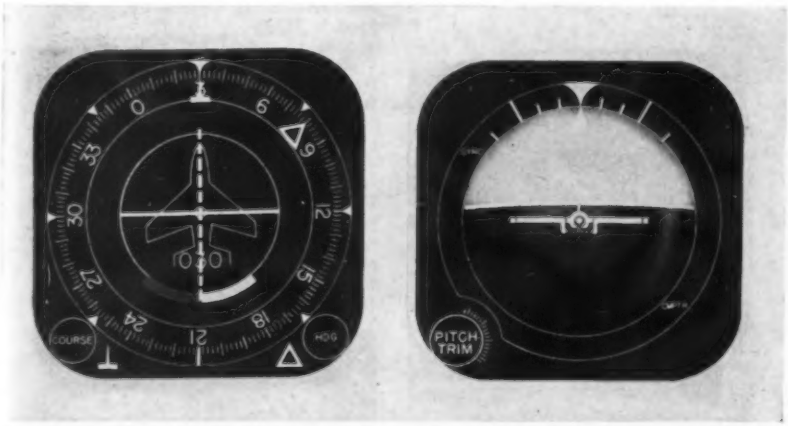
TRIM TAB INDICATOR

Mfr.: Daystrom, Inc.
Model: CORMAG
Remarks: Three core magnet zero-center mechanisms operate to display trim tab position in automatic pilot installations.

ATTITUDE INDICATOR

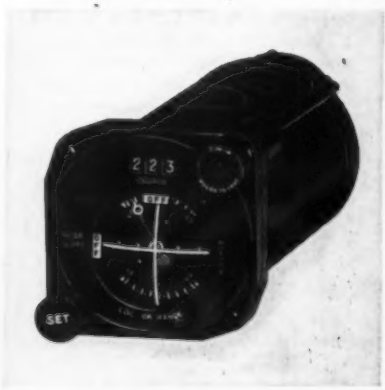
Mfr.: Sperry Gyroscope Co.
Remarks: Eight-pound H-10 instrument provides extremely accurate flight-data information on position of aircraft. Measures and pictures exact degree of bank, dive or climb. Has long rundown period of 12 min. in event of aircraft electrical system failure.

Eclipse-Pioneer offers new flight-director system



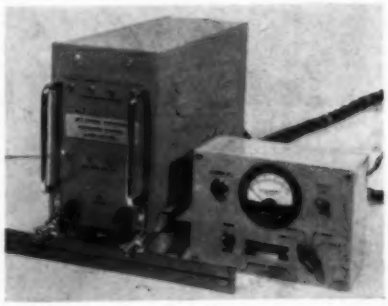
FLIGHT-DIRECTOR SYSTEM now being marketed by Eclipse-Pioneer Div., Bendix Aviation Corp. is designed to combine easy-to-read display with complete picture of flight attitude. System consists of five units—course deviation indicator (left), horizon director indicator (right), a computer, vertical gyro and an amplifier. Series 100, 200 and 300 vary in the amount of information displayed and manner in which it is presented. Indicators have 4" dial faces.

COURSE INDICATOR



Mfr.: Weston Electrical Instrument Corp.
Model: 1856
Size: 8" x 3¼" x 3¼"
Weight: 3.75 lbs.
Ratings: 150-0-150 microamps, 250-0-250 microamps; 26v, 400 cps; 0.36v, 30 cps; 11.8v, 400 cps; 28vdc.

HEADING/DISTANCE BEARING INDICATOR
Mfr.: Weston Electrical Instrument Corp.
Model: 1164
Size: 7" x 3¼" x 3¼"
Weight: 3 lbs.
Ratings: 115V, 400 cycle.
Remarks: For aircraft use.



JET ENGINE VIBRATION INDICATING SYSTEM
Mfr.: Land Air, Inc.
Size: 12.5" x 7.5" x 5"
Weight: 10 lbs.
Ratings: 6 watts; 2% accurate; 700°F.
Remarks: For turboprops and jets; completely transistorized.

TURBINE ENGINE VIBRATION INDICATOR
Mfr.: Sperry Gyroscope Co.
Weight: 12 to 24 lbs. depending on number of engines.
Remarks: For turboprops & jets; warns of impending engine trouble by indicating "foreign" vibrations exist. Consists of short ½ ATR rack with four amplifier modules, four indicators, pick-up and warning lights.

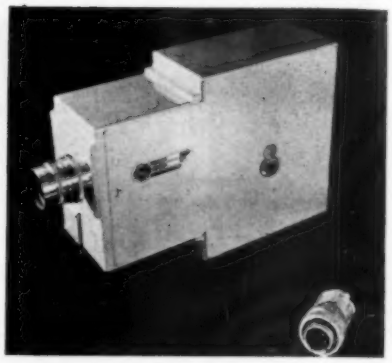
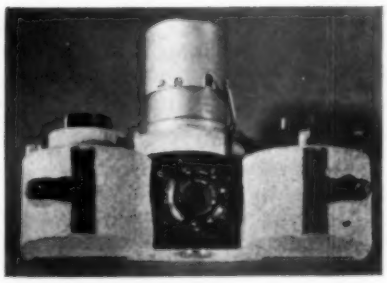
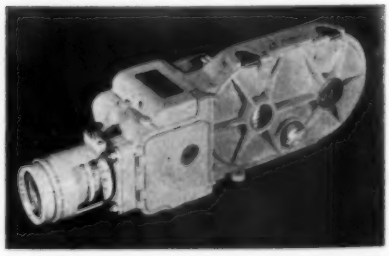


PHOTO DATA RECORDER
Mfr.: Vought Co.
Model: VDR-52T
Size: 9⅛" x 3" x 6½"
Weight: 7 lbs.
Ratings: 200 frames per sec. 200 ft. capacity; 16 mm.
Remarks: Airplane and missile test evaluation; intermittent action.



TIME-LAPSE CAMERA
Mfr.: Wollensak Optical Co.
Model: TL-35
Size: 6½" x 4-13/16" x 2-27/32"
Weight: 2.5 lbs.
Ratings: 35 mm x 50 ft.
Remarks: For aircraft and missiles.

FASTAIR CAMERA
Mfr.: Wollensak Optical Co.
Size: 13-15/64" x 4-17/32" x 3-35/64"
Weight: 8.5 lbs.
Ratings: 16 mm x 100 feet.
Remarks: For aircraft and missiles.



New product data — instruments

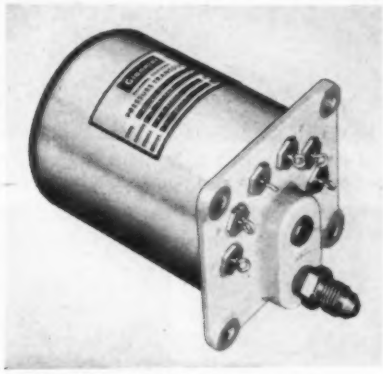
Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Accelerometer, angular	Edcliff Instruments	6-9	2¼" dia. x 2.5"	1	From —50 rad/sec² to —5,000 rad/sec²	Potentiometer type roll control device for missiles, aircraft.
Accelerometer, axial	G. M. Giannini Co.			8-17 oz.	+1 to ±30g	Aircraft and missiles.
Accelerometer, high frequency	Gulton Industries	AD-14	.715" x .475"	10 gr.	200g-25 to 20,000 cps 50°F to 450°F	Sensitivity 1 mg/g.
Accelerometer, high g	" "	A-330	1¼" x 1 5/32"	1¼ oz.	1-10,000g, 20,000g limit	Drop tests and projectile impact.
Accelerometer, linear, ac	Edcliff Instruments	7-32	2" dia. x 2"	6 oz.	From —.25g to —100g	For missiles and aircraft.
Accelerometer, linear servo	Donner Scientific Co.	4112	2.75" x 4.2"	1.3	±0.1g to ±20g Output ±0.1 to ±15 volts	Linear acceleration measurement, pendulous type.
Airspeed & machmeter	Pioneer-Central, Div. Bendix Aviation Corp.	1454	4⅛" L 3¼" sq. bezel	1¼	80-850 knots .4-2.5 mach, 1,000-80,000 ft. alt.	Meets new Navy standards for increased range per MIL-L-19570.
Airspeed indicator (max.-min.)	Pioneer-Central	1449	7" L 3¼" sq. bezel	3½	50-650 knots drum types vernier sub dial —1,000 to 50,000 ft. alt. .6 to 1.0 mach	Mach airspeed for aircraft subject to critical landing and takeoff conditions.
Airspeed indicator	" "	1455	4" L max. 3¼" sq. bezel	1.5	5-300 knots	Extremely sensitive at low air speeds. For helicopters and convertiplanes.
Analyzer-engine	Land-Air, Inc.	136	total 3 modules 0.7 cu. ft.	27	Vibration or ignition analysis, 400 cycle 250 watts	For reciprocating engines, to MIL-A-19129 (AER) 9207 B. (USAF)
Automatic direction finder indicator	Aviation Instrument Mfg. Corp.	1080-1	3 21/64" x 3¼"	1 lb. 1 oz.		For use for advanced ADF systems.
" "	" "	1080-2	4 1/16" x 3¼"	1 lb. 6 oz.		" " " " " "
Camera, aerial	Konica Camera Co.	KAC	9¾" x 6¾" x 6"	6	1/50, 1/100, 1/200, 1/400th sec. shutter speeds	Aerial spotting camera.
Camera, aircraft body	Hycon Mfg. Co.	LA-11	15⅞" x 16 11/16" x 5⅞"	35	Shutter assembly for 9x9" format. 6" to 40" lens	Parts of universal camera control system.
Camera, automatic reconnaissance	" "	KA-20	13⅜" x 12" x 12⅝" 9 x 9" film	17½	IMC, shutter 1/150 or 1/300 sec.; 75' of 9½" film	Army Signal Corps use on RP-71 drone, L-19 & L-20.
Camera, day reconnaissance	" "	KA-13	25" x 17" x 14⅞"	100	9x18" IMC camera for 12 to 48" lenses. Takes 1000' 9½" film.	
Camera, reconnaissance	" "	K-36	24" x 17⅛" x 21¼"	135	100' of 18½" film.	For night use.
" "	" "	K-46	13" x 10⅞" x 21¼"	25	250' of 5" film IMC. Cycling rate 2 per sec.	(Part of UCCS system.) Used on RB-66.
" "	" "	KA-4	13½" x 8" x 12¾"	28	Fast cycling camera using 250' of 5" film	Part of UCCS system (day).
Camera, recording	Abrams Instrument Corp.	CRZ-6	18" x 18"	75	35 mm, 100 ft. film	Selective sweep recording of 12" PPI with data.
Camera test set	" "	LM-22	17" x 21" x 6"			Test set is for entire KA K-38, K-46, K-47 K-50, LA-11, T-11, KC-1, K-17C, K-36.
Clock, aircraft	Wakmann Watch Co.	W-33-7510	2⅜" x 2⅜" x 3 6/32"	½	5-day, type A-11	Panel clock, qualified products list.
" "	" "	W-33-7511	2⅜" x 2⅜" x 3 6/32"	½	8-day, 24-hr. dial	24-hour panel clock.
" "	" "	W-33-7510ET	2⅜" x 2⅜" x 3 6/32"	½	8-day	Elapsed time type A-11 aircraft clock.
" "	" "	618-12	3 35/64" x 3 29/64" x 2⅛"	.83	8-day	Elapsed time modified type A-10A aircraft clock.
" "	" "	618-24	3 35/64" x 3 29/64" x 2⅛"	.83		24-hour elapsed time aircraft clock.
" "	" "	640-12	3 35/64" x 3 29/64" x 2⅛"	.83		Type A-10A aircraft clock spec. MIL-C-9196.
" "	" "	640-24	3 35/64" x 3 29/64" x 2⅛"	.83		24-hour modified type A-10A aircraft clock.
Compass system master indicator	Sperry Gyroscope Co.	C-11	10 1/16" x 3⅛" dia.	4.5	½ deg. max. to ⅛ deg. drift/hr.	Gyrosyn system for long-range, high-speed aircraft; for over-the-pole transoceanic flights.
Controller			5¾" x 3¼" x 2⅝"	1		
Flux valve			4⅞" x 3½" x 2 5/16"	1.5		
Rack			¼ ATR	5		
Compass system master indicator	" "	C-10	10 1/16" x 3⅛" dia	4.25	Less than 3°/hr. drift	All transistorized; auto-compensation for earth's drift.
Controller			5¾" x 3¼" x 2⅝"	1		
Directional gyro			8 1/4" x 7¼" x 7½"	8.75		
Flux valve			4⅞" x 3½" x 2 5/16"	1.5		
Rack			¼ ATR	5		
Cooling effect detector	Barber-Colman Co.	AYLF	1.56" x 50" x .62"	approx. .06	Resistance at 77°F 550r ± 55r	
Count limiter	Abrams Instrument Corp.	CN1-A1	3.5" x 2.25" dia.	½	Respond to 40 cps 120 counts adj.	Predetermining counter to adjustable number 1-120.
Counter rounds	" "	PR-1	2" x ⅝" dia.	¼	179 rounds, 40 cps	Accurate dial type counter to 40 cps.
Distance, heading, bearing indicator	Daystrom Instruments	1163	3¼" dia.		Mileage digital counter and dial	For Tacan, AN/ASN-8 and radio compass readings.

New product data -- instruments *(Continued)*

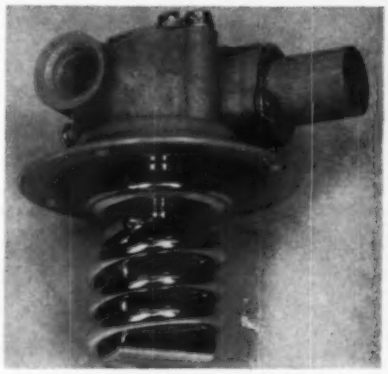
Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Dual long scale indicator	Weston Electrical Instrument Corp.	859	7" x 3¼" x 3¼"	1.5	5.0 Milliamperes d.c.	For aircraft use.
Engine exhaust temperature indicator	Ford Instrument Co., Div. Sperry-Rand Corp.	ET 1	6" x 2" dia.	16 oz.	200 to 1000°C coarse & vernier scales	Navy BuAer development for turboprops and turbojets. Silicon transistors used.
Gyro direction indicator	Aviation Instrument Mfg. Corp.	2DG	5.23" x 4½" x 4½"	2 lbs. 15 oz.	Suction 3½" to 4½" hg cons. 1cfm.	Air-driven.
Gyro, free	G. M. Giannini Co.	3916	4.84" x 4.0"	5.5	Inner gimbal ±83° Outer gimbal ±177°	Aircraft and missile guidance.
Gyro, rate	" "	36628	3.55" x 2.02"	28	± 10°/sec to ±300°/sec Resolution 0.05%	Pitch and yaw rate data in control and telemetering.
Heading, distance bearing indicator	Weston Electrical Instrument Corp.	1164	7" x 4" x 4"	4.0	115v 400 cy.	For aircraft use.
Horizon reference indicator	Aviation Instrument Corp.	643	7⅛" x 3 3/16"	2 lbs. 4 oz.	Suction 4"± ½" hg cons. 2.3cfm	Air-driven.
Intervalometer	Abrams Instrument Corp.	B-8B	7" x 5" x 6"	8	8 amp output/28 vdc	Bomb damage evaluation camera control.
"	" "	B-9A	6" x 2.25" dia.	1.6	3 amp output/28 vdc	High precision timing pulse unit, variable ½ to 60 sec.
"	" "	B-10A	6" x 2.25" dia.	1.6	3 amp output/28 vdc	High precision timing pulse unit, variable ½ to 12 sec.
"	" "	MF-1	9" x 4" x 5"	5	40 amps/28vdc output	High precision, sequence firing control.
"	" "	SR-1	6" x 3" x 4"	2	25 amp output	High precision, sequence firing control.
Long scale indicator	Weston Electrical Instrument Corp.	955	2¾" x 3¼" x 3¼"	0.9	100 microamperes d.c.	For aircraft use.
Machmeter	Pioneer-Central	1462	6½" L 3¼" bezel	2 max.	0.7-2.0 mach —1,000 to 80,000 ft. alt.	Integrally lighted MIL-L-25467A). Designed for B-58 and other high performance aircraft.
Magazine, aircraft camera	Hycon Mfg. Co.	A9B	15" x 14¾" x 8"	20	390' of 9½" film. Cycles at 1 per sec	(Day or night.)
Photo data recorder	Vought Co.	VDR-4B	7⅝" x 4" x 5"	8	100' capacity, pulse rate up to 10 per sec, 16 mm	Pulse-operated; for photo panel recording.
" " "	" "	VDR-42B	9¼" x 4" x 6½"	9	200' capacity, pulse rate up to 10 per sec, 16 mm	Pulse-operated; for photo panel recording.
" " "	" "	VDR-5T	7⅝" x 3" x 5"	6	200 frames per sec, 100' capacity, 16 mm	Airplane and missile test evaluation; intermittent action.
" " "	" "	VDR-10	20" x 6" x 8"	40	96 frames per sec, 400' capacity, 35 mm	Aircraft and missile test; intermittent action, 1,000' magazine available.
" " "	" "	VDR-11	15" x 4" x 12"	20	24 double frames per sec, 200' capacity, 35 mm	Aircraft and missile test wide angle frame.
Potentiometers	Servonic Instruments, Inc.	G	¾" dia.		1" to 20" stroke	Aircraft and missile telemetering and servo control systems.
Safeather system	Aviation Instruments Mfg. Co.	1073	sensor-4" x 1⅜" x 2 3/16" button-1½" x 1¼" dia.	4		An automatic power failure indicator. (Twin engine aircraft.)
Speed control	Safe Flight Instrument Corp.	SC-12	3½" x 1½" x 1½" transducer model	4½	12 vdc, .5a	Installation time 16 man-hrs. Computer model measures 3½" x 5" x 4".
Speed control	Safe Flight Instrument Corp.	SC-24	3½" x 1½" x 1½" transducer model	6	27½ vdc, .5 a	Installation time 24 man-hrs. Computer model measures 5" x 6" x 8½".
Tailpipe temperature indicator	Daystrom Instruments	955	2¾" dia.		Various voltage and current ranges	Panel instrument.
Temperature probe	Rosemount Engineering Co.	101	2.5" dia. x 3.8"	.35	—100°C to +350°C	High-speed aircraft.
" "	" "	106	2.5" dia. x 3.8"	.35	—100°C to +650°C	High-speed aircraft.
" "	" "	102	2.5" dia. x 4.7"	.45	—100°C to +400°C	High-speed flight test aircraft.
" "	" "	108	1.5" d a. x .25"	6 gr.	To +500°F	Surface temperature measurement.
" "	" "	110	.6" x .6" x 2.3"	15 gr.	To +500°F	Gas or liquid temperature measurement.
" "	" "	119	.6" x .6" x 2.3"	15 gr.	To +500°F	Gas or liquid temperature measurement.
" "	West Coast Research Corp.	T-2004	¾" x 4"	6.02	To 200°F and to 650°F	Missiles and aircraft air temperature sensor.
Thermostat	George Ulanet Co.	28	1⅝" x 19/32" x 7/16"	.216 oz.	5A, 28V, dc or 5A, 115V ac	Hermetically sealed aircraft and missiles.
Timer	Wakmann Watch Co.	605A				AN 5742-1 18-jewel made according to spec. MIL-W-6510.
Timer, subminiature, motor driven	Advanced Products Co.		1½" dia.	6 to 16 oz.	DC or AC, 5 to 10 amps, 1 to 6 switches	Accuracy for ac units is ± 2%, and ± 5% for dc. For missiles and aircraft.
Transducer, hi-temperature	Consolidated Electrodynamics Corp.	4-317	⅛" x ⅜"	30 gr.	Pressures of 10-5,000 psi. Linearity less than ±1.5%	For —350°F to +600°F and transients to +750°F.
Transducer, pressure	G. M. Giannini Co.	451218	1" x 1" x 1"	3 oz.	0-15 psi to 0-50 psi resolution 0.33%	Smallest potentiometer output pressure transducer. Used on earth satellite.
" "	Dynamic Instrument Co.	PT 32	2/10" OD		0-7,000 and 0-15,000 psi, —65°F to +350°F	Wide temperature range capability, miniaturized.
" "	Servonic Instruments, Inc.	H	4⅛" x 1½" x 1½"	22 oz.	Range from 1,000 to 10,000 psi	Aircraft and missile telemetering and servo control systems.
Transducer, Temperature (Stikon)	Arthur C. Ruge Assoc., Inc.	T-56			—100°F to 600°F	Temperature sensitive wire between glass cloth pieces for surface applications.

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Transducer, Temperature (Strapon)	1" x 1" x 1/8"				—100°F to 500°F	Stainless steel mounted element.
Transducer position	West Coast Research Corp.	4-557-3	1" x 1" x 1"	2.0	Rotary or linear	Shaft pos., angle of attack antenna pos., gimbal angle, etc.
Transducer pressure	Consolidated Electrodynamics	4-317	5/8" x 3/4"	30 gr.	100 to 5,000 psi —350°F to +600°F	For wide-range temperature environmental conditions.
Trim tab indicator	Weston Electrical Instrument Corp.	1889	1 3/4" x 4" x 2"	0.5	28 vdc	For aircraft use.
Turn & slip indicator	Pioneer-Central	3922	5 25/32" L 3 1/4" sq. bezel	1 1/2 max.	115 Volt single phase 400 cycle (14V.A. Max.)	Integrally lighted MIL-L-25467A). Integral power failure indication. For jet transports.
Vertical velocity indicator	" "	1654	5 1/2" L 3 1/2" sq. bezel	1.75 max.	2,000-0-2,000 & 6,000-0-6,000 ft/min	Integrally lighted MIL-L-25467A). Rapid response design.
Vibration indicator	Kistler Instrument Corp.	VI-125	4" x 4" x 2"	2	High-temp quartz shock & vibration indication	Missile and aircraft powerplants.
Watch	Wakmann Watch Co.	605A				AN 5742-1 18-jewel navigational stopwatch MIL-W-5605.

AIRCRAFT CLOCK
Mfr.: Wakmann Watch Co.
Model: 618-24-100
Size: 3-35/64" x 3-29/64" x 2 1/8"
Weight: 8.3 lbs.
Remarks: Combination 24 hr. dial; 1/100 min., 8-day clock.



PRESSURE TRANSDUCER
Mfr.: G. M. Giannini & Co.
Model: 451212
Size: 4.07" x 2.78"
Weight: 18 oz.
Remarks: 0-10 psi to 0-100 psi; resolution 0.067% to 0.05%. For critical airborne applications.



RAM TEMPERATURE SENSOR
Mfr.: Manning, Maxwell & Moore, Inc.
Model: 155F6
Remarks: Fast-response temperature-sensing system for jet engines operating in Mach 3 regime. Time response is 1.5 secs. for airflow of 35 lbs./sq. ft./sec.

Directory of manufacturers

For additional information on products listed in this section, write to manufacturer at address below attn. sales manager. Give page number and refer to AMERICAN AVIATION ENGINEERS HANDBOOK of New Products.

Abrams Instrument Corp., 606 E. Shiawassee St., Lansing 1, Mich.
Advanced Products Co., The, 59 Broadway, North Haven, Conn.
Aviation Instrument Mfg. Corp., Houston International Airport, P.O. Box 12272, Houston 17, Tex.
Barber-Colman Co., 1437 Rock St., Rockford, Ill.
H. J. Burke Co., 49 Washington Ave., Little Ferry, N. J.
Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.
Daystrom Instruments, Archbald, Pa.
Donner Scientific Co., 888 Galindo St., Concord, Calif.
Dynamic Instrument Co., 28 Carleton St., Cambridge 42, Mass.
Edcliff Instruments, 383 N. Foothill Blvd., Pasadena, Calif.
Ford Instrument Co., Div. of Sperry Rand Corp., 31-10 Thomson Ave., Long Island City, N. Y.
General Electric Co., Light Military Electronic Equipment Dept., Schenectady 5, N. Y.
G. M. Giannini Co., 918 E. Green St., Pasadena, Calif.
Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.
Hycon Mfg. Co., 707 So. Raymond Ave., Pasadena, Calif.
Kistler Instrument Corp., 15 Webster St., N. Tonawanda, N. Y.
Konica Camera Co., 76 W. Chelten Ave., Philadelphia 44, Pa.
Land-Air, Inc., 7444 Wilson Ave., Chicago 31, Ill.
Manning, Maxwell & Moore, Inc., Danbury, Conn.
McLean Development Laboratory, Inc., Copiague, N. Y.
Pioneer-Central Div., Bendix Aviation Corp., Hickory Grove Rd., Davenport, Ia.
Robinson Aviation, Inc., Teterboro Air Terminal, Teterboro, N. J.
Rosemount Engineering Co., 9429 Hyndale Ave., So., Minneapolis, Minn.
Arthur C. Ruge Associates, Inc., 733 Concord Ave., Cambridge 38, Mass.
Safe Flight Instrument Corp., 4 Water St., White Plains, N. Y.
Servonic Instruments, Inc., 640 Terminal Way, Costa Mesa, Calif.
Sperry Gyroscope Co., Div. of Sperry Rand Corp., Great Neck, N. Y.
Vought Co., P.O. Box 1350, Beverly Hills, Calif.
Wakmann Watch Co., Inc., 15 W. 47 St., New York 36, N. Y.
West Coast Research Corp., 2371 1/2 Westwood Blvd., Los Angeles 64, Calif.
Weston Electrical Instrument Corp., Newark 12, N. J.
Wollensak Optical Co., Rochester 21, N. Y.

Other product sources

Accelerometers—B&F Instruments Inc.; low and medium frequency models 3 to 100g.

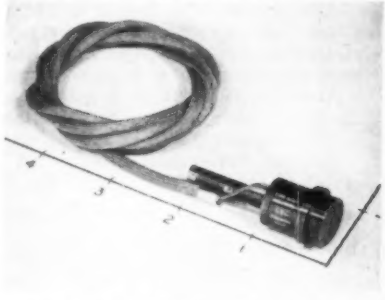
Compass system—General Electric Co., Instrument Dept.; lightweight system for executive aircraft; distributed by Wilcox Electric Co.

Course indicator—Daystrom, Inc.; heading-cross-pointer type for localizer, glide slope and marker beacon.

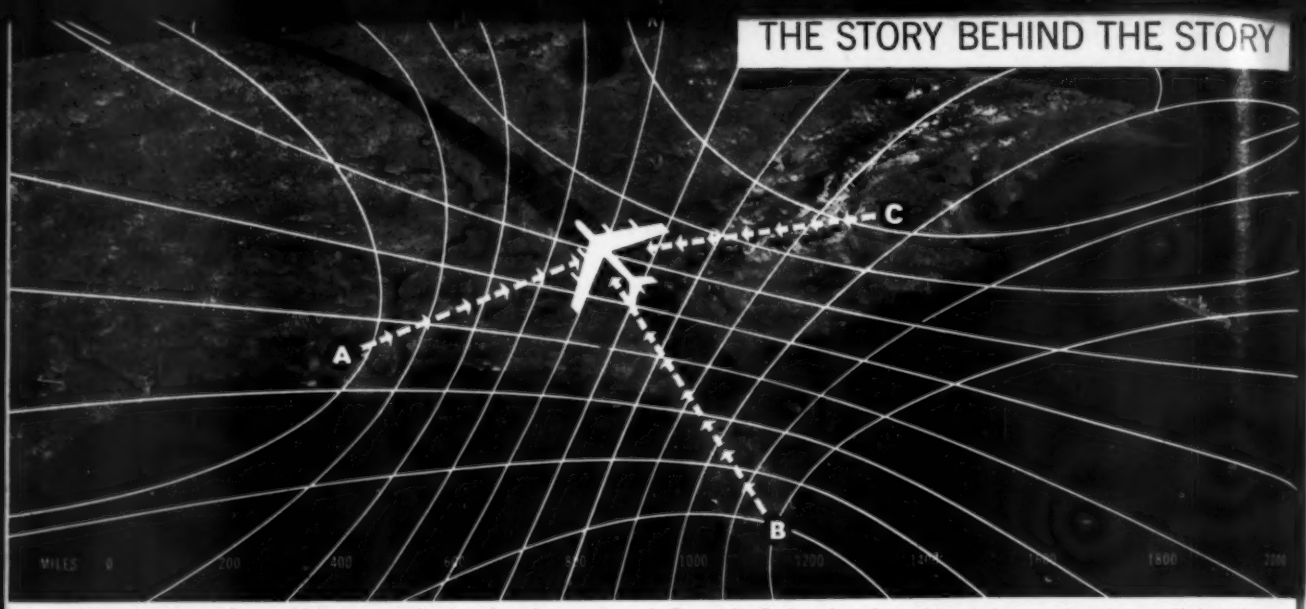
Indicator—Daystrom Instrument, Daystrom, Inc.; dead reckoning display for short-range aircraft at 2.5 to 50 miles.

Transducer—Electro Products Laboratories; variable reluctance speed indicator input element.

HI-TEMP PRESSURE TRANSDUCER



Mfr.: Consolidated Electrodynamics Corp.
Model: 4-317
Size: 5/8" dia., 3/4" long
Weight: 30 grams
Ratings: 100-5,000 psi.
Remarks: For temperature range of -350°F to +600°F and transients to +750°F. Linearity is ±15%. Can sustain 100g.



CYTAC SIGNALS from widely separated pairs of stations such as A, B and B, C give aircraft or ships their exact location at all times by providing "hyperbolic" lines of position. Position is indicated automatically and continuously for instant reference.

IN CONTRAST to CYTAC, line-of-sight radio signals—similar to television – are limited by earth's curvature. Such signals, therefore, give limited coverage at low altitudes.

VAST RANGE of CYTAC extends 1500 miles over land, 2000 miles over water, at all altitudes. Theoretical range is limited only by power of transmitters sending out signals.

CYTAC: SOLUTION TO NATION'S GROWING AIR AND SEA TRAFFIC PROBLEM

Simplified long-range navigation system accurate over land and water

Safe, precise control of our fast-growing air and sea traffic is a top-priority project today. Development of CYTAC now promises to solve the problem.

This unique new Sperry hyperbolic system enables both long and short range aircraft as well as ocean liners to locate their exact position with unprecedented accuracy at all times. Its low-frequency signal reaches 1500 miles over land, 2000 miles over water.

Another key feature of CYTAC is its ability to operate accurately at low altitudes. CYTAC signals simply flow around buildings and other obstacles which block signals from high-frequency line-of-sight systems now in use.

Equally significant is CYTAC's low cost in providing transmitter coverage. To set up a 24-hour, all-weather, air-sea navigation system blanketing the U. S. and adjacent sea lanes requires erection of only 15 transmitters.

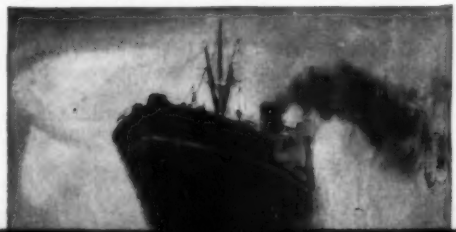
This is only one of the developments of Sperry's new Air Armament Division. Other fields of activity include air-to-air and air-to-surface missiles, airborne beacons, countermeasures, fire control radars, inertial systems and bombing-navigation systems.

AIR ARMAMENT DIVISION

SPERRY GYROSCOPE COMPANY
Great Neck, New York
DIVISION OF SPERRY RAND CORPORATION

LOW-FLYING helicopters often find line-of-sight guidance blocked by tall buildings. CYTAC operates even at ground level with high accuracy.

SHIPS AT SEA, even in mid-ocean, can fix position exactly with CYTAC by long-range signals transmitted from shore. CYTAC operates continuously, night and day, in all weather.



TRANSCONTINENTAL AIRLINERS now check 30 or 40 radio beacons in crossing U. S.; with CYTAC, only 4 station changes would be necessary.

Electronics equipment market: bigger than ever

by Henry P. Steier

ELECTRONICS FIRMS with an eye to the future should have a big stake in the equipment market that is developing rapidly as air traffic control engineering effort gains speed to cope with the dual problems of mounting air travel and impending civil jet operations.

New life was breathed into ATC research and development planning by recent increased appropriations for CAA and establishment of the Airways Modernization Board.

Effects of this have already begun to show in the clearer picture that can be drawn from recent announcements made by CAA and AMB on their future planning and equipment needs to carry out the work.

Although there is widespread speculation that, if and when the Federal Airways Board is established by Congress to supplant the AMB, it will also absorb the CAA as part of its organization, the roles of groups such as CAA for application engineering and AMB for R&D will remain. Life of the AMB covers the 1957-1960 period.

Present planning objectives of each if these groups will serve as a valid guide to opportunities offered manufacturers for equipment development.

Recently, CAA disclosed its ATC development and evaluation program, which has been outlined to 1960. Major elements in the program are flight-data processing, flight-plan display, radar aids to data acquisition, radar displays and simulation techniques.

Although CAA planning includes provision for some tie-in of its system with the military air defense environment, there is increasing indication that civil ATC needs will be different enough from military ones to require a whole new family of equipment to suit problems peculiar to civil activities.

Flight-data processing

The most knotty job facing ATC is handling data on air traffic. The safety of aircraft is acutely vulnerable today to the speed and accuracy with which such data are handled.

The size of this problem can be seen in the average 1,200 flight progress "strips" handwritten, calculated and manually distributed in the New York Center during on instrument-flight-rule-hour. Strips are produced at a rate of 100 every five minutes.

Up to 50% of a controller's time may be spent in routine clerical work. To this handicap can be added the chance of misreading a hastily written strip which may include a mathematical error made by an assistant controller in computing an estimate.

CAA points out there will soon be 10,000 personnel actively engaged in ATC, and if each of these commits only one serious error per year there would be 27 serious clerical errors per day in the U.S.

First step in modernizing a control room to exclude safety hazards and speed up this work is now being taken at CAA's Technical Development Center in Indianapolis. A device known as FLIDEN (Flight Data Entry) is undergoing inservice evaluation at the Indianapolis Air Route Traffic Control Center.

Telephone information from outlying air routes is telephoned to an operator who punches the information into punch cards with a typewriter-operated IBM 826 key-punch machine.

A runner carries the cards to an IBM card-reader which transfers the information to a 650 computer. The computer is programmed to handle 300 airways routes using information supplied to it on air speed of a given flight, time, route and destination. It calculates arrival time at check points and destination, and miles to go.

This information is fed to punch cards again. These are fed to an IBM 407 printer for automatic preparation of printed flight progress strips. There is no conflict-search in the 650 machine, nor storage of the flight plan. Such work must be done by human controllers.

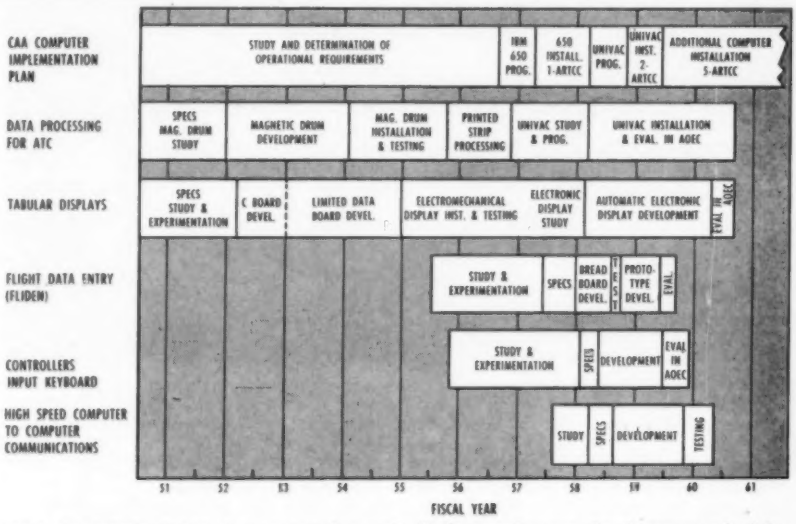
Next step planned by CAA is installation of an IBM RAMAC random access data machine. This will search for conflicts and have a bigger capacity for data-handling than the present system.

This work is being done as a guide to programming of two Sperry-Rand UNIVAC file computers that are tentatively planned for installation at the New York and Washington ARTC centers in fiscal 1958-1959.

Needed are advanced input and output equipments suitable for CAA work and the gradual evolution of partial to more complete automatic data processing.

One of the big headaches is planning for equipment needs peculiar to ATC data-processing and implementation, so that obsolescence will not occur because of non-compatible input and output arrangements.

A special typewriter input device is being developed under contract by Aeronutronic Systems, Inc., subsidiary of Ford Motor Co. so that information can be fed to a computer in suitable



CAA FLIGHT PLAN data processing and display equipment development schedule.

form to match its programming. Delivery of this unit is expected in 1958.

The prototype of this device will serve as a guide to procurement of such equipment for the CAA implementation program. There will be need for evaluation of other such devices as the computer design needs become more clear.

Although UNIVACs are called for in CAA planning there is some question of whether their cost can be justified at this time. The capacity of such machines is so great that present input means could not keep it fed with information on an efficient basis.

The AMB will award a contract in 1957 for a breadboard model of a complete data-processing system. This, however, will be an R&D project aimed at analysis of a complete system and probably will call for specialized hardware that will not see actual service until 1962.

AMB plans call for use of the New York area as the research environment for the system and services tests. These include exchange of information with a sector of the SAGE system and tests are expected in 1960.

At this time need is for data-processing equipment that suits current and near-future anticipated needs of CAA traffic control and which match the capacity and economy of the present situation.

By fiscal 1959, CAA estimates there will be a total of eight computer installations in the CAA system. The layout of these may be such that a number of centers surround one center equipped with a computer.

Hardware to transfer information at a high rate from these centers to the computer center is needed, as well as hardware to interconnect all of the the computers.

Display of flight data will be automated in line with the aim of reducing clerical operations. The effort here will be concentrated on replacement of manual insertion of flight progress strips on posting boards by new types of electro-mechanical or electronic hardware.

In 1952 CAA started development of data transfer and display equipment. Electromechanical boards with rotating letter and number wheels were built. They were found to be suitable only for application in certain terminal areas where amount of data is limited and requirement for rapid sequencing and reshuffling of data does not exist.

Opinion now is that electronic means to do this are needed. This work may begin in 1958 with a human engineering study. A development contract calling for production of such a device in two years would enable its evaluation. It would also provide guidance for procurement to fulfill the high percentage of automation called for in planning input and data-processing, which would make 83% of the work automatic at that time.

It has not been determined whether a direct-view cathode ray tube such as the Charactron or a projected display device would best serve the data display need.

Advent of long range radar in CAA operations will increase the demand for improved radar displays. Standard 10- to 12-inch direct view radar indicators are not bright nor large enough to permit a controller to add written or other identifying information alongside an aircraft signal blip on a display representing hundreds of miles.

CAA has installed old wartime Navy VG projection indicators at Washington, New York and Chicago centers. These require weekly displacement of the picture tube and a subsequent 4-5 hour job to realign the system's optics.

The VG units cannot be adjusted for off-center operation or expanded to show particular centers of interest in greater detail.

CAA has found the best way to get most use of long-range radars is to project data from them on a plotting display with a scale factor of 2-3 miles per inch.

With a large display target markers containing control information can be used. In this way all data necessary for control is on one display.

Major handicap in the display problem is lack of suitable tube devices for producing large, bright image. As things stand U.S. hardware is not satisfactory, and European manufacturers appear to have the lead in display gear.

The Europeans have gotten around the problem by using scan-conversion or photographic projection techniques.

One means of getting bright displays is the scan-conversion technique. This uses large TV type tubes capable of high brightness. Radar data of PPI scan is converted to TV-type scan.

Dumont SRD-1 scan-conversion equipment using a graphecon tube to convert the rho-theta scan to TV scan has insufficient dynamic or gray scale range and inadequate "trail" or history information to maintain identity of an aircraft.

The IATRON storage tube developed by Farnsworth Electronics Co. has been evaluated and found to have inadequate trail and resolution.

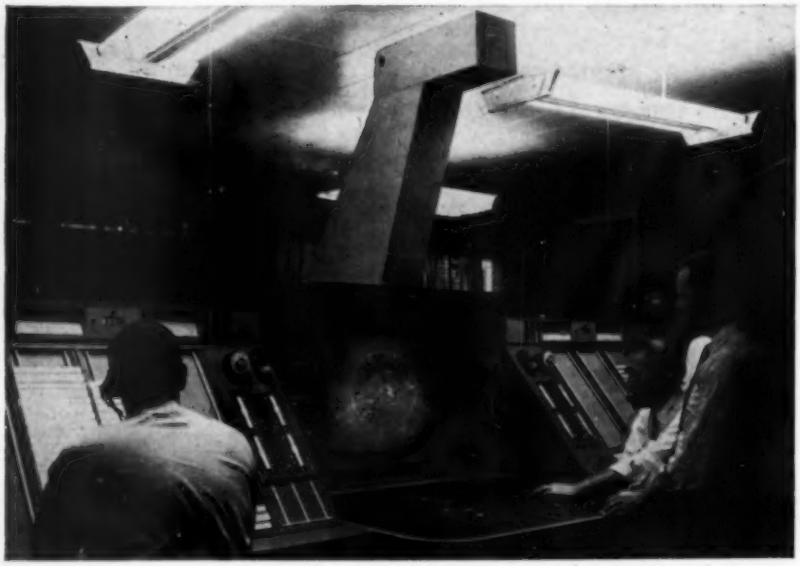
At this time a French scan-conversion system and a British projection display system are being evaluated. A system called SPANRAD (Superimposed Panoramic Display) uses TI-440 equipment made by the French CSF Co.

It is in use by the French Navy and was originally developed to fulfill the European need to convert from one European TV transmission standard to another since these differ in number of lines and other signal characteristics.

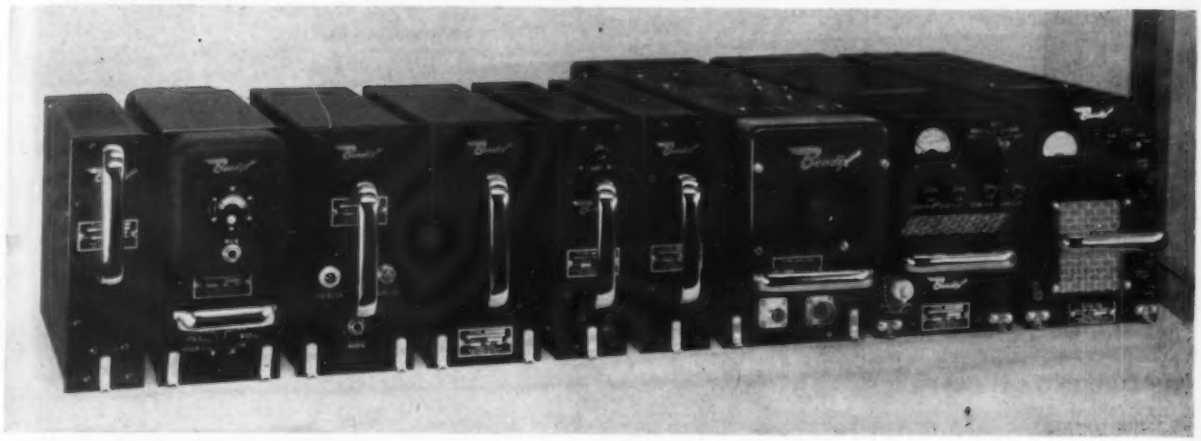
Using a French-developed signal converter tube dubbed "Frenchicon" and electronics gear, SPANRAD converts PPI information to a TV scan on a 27-inch TV tube. Plotting table information with markers is picked up by a Vidicon and superimposed on the TV radar display. Operation in a brightly lighted room is possible.

Another system, made by Kelvin-Highes, Essex, England uses a 2,000-line radar indicator tube, camera, rapid film processor and projector built into one unit. One PPI radar rotation display is photographed, developed and ready for projection in 6-10 seconds. Projection may be made on a movie-size screen.

This equipment is in use by RAF fighter command facilities in England and have been procured by the USAF for evaluation in the SAGE system. Two units are now on loan to TDC for ATC work.

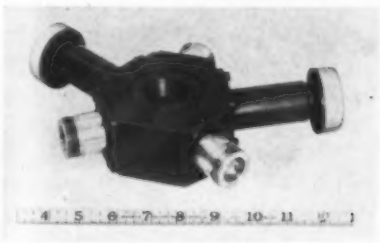


SUPERIMPOSED panoramic radar display (Spanrad) combines radar display and operations board image on same TV picture tube. Overhead box contains Vidicon TV pickup for obtaining image of board. Scan conversion is done by French equipment.

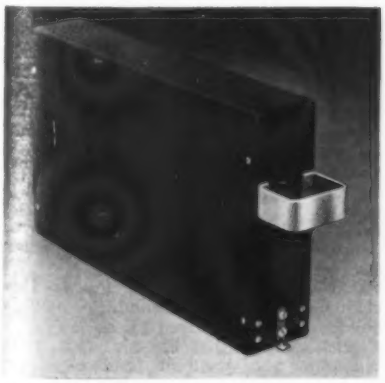


AIRBORNE ELECTRONIC SYSTEM
Mfr.: Bendix Radio Div., Bendix Aviation Corp.
Remarks: For jet and turboprop and twin-engine business aircraft complete communcations, navigation and radar system. New radar-transmitter weighs 79 lbs., glide slope receiver 6.5 lbs.; marker beacon 6.5 lbs.; VHF transmitter 13.5 lbs.

HI-POWER COAXIAL SWITCH
Mfr.: Transco Products, Inc.
Remarks: Single-pole, double-throw switch for frequencies to 5,000 mc. For airborne and ground-based ECM. Available with LT, LN, LC, TRU and ⅞" cable fittings. Weight, 4½ lbs.

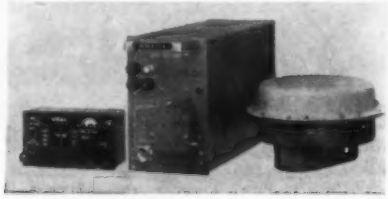


GLIDE SLOPE RECEIVER
Mfr.: Lear, Inc.
Model: LGSR-1
Size: ¼ ATR short



Weight: 5 lbs.
Ratings: 20 frequencies 329.3 to 335 mc.
Remarks: Transistorized power supply. Solenoid drive crystal selection switch.

VHF TRANSCEIVER
Mfr.: Aircraft Radio Corp.
Model: 210
Size: 3/8 ATR
Weight: 22 lbs. complete
Ratings: 118.0-135.95 mc, 360 channels, 50 kc spacing, output 15 watts.
Remarks: Printed circuitry on glass-epoxy treated for high moisture conditions.



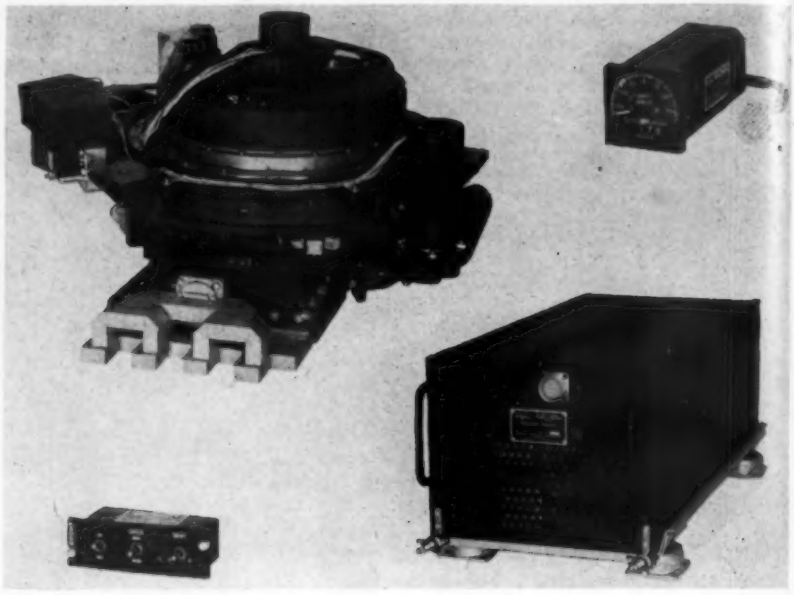
ADF RECEIVER
Mfr.: Wilcox Electric Co., Inc.
Model: 701A
Size: ½ ATR
Weight: 13½ lbs.
Ratings: 90-1750 kc in 4 bands
Remarks: New control head and ferrite core antenna loop designed for retrofit.

CHARACTRON
Mfr.: Stromberg-Carlson
Model: Short
Size: 5" dia., 17½" long
Remarks: New short version for radar display, character and numeral printing in air data display devices.

VHF RECEIVER
Mfr.: Gonset Division, L. A. Young Spring & Wire Corp.
Remarks: New series of AM & FM receivers for communication monitoring. Units have 8 tubes plus rectifier, operate from 115v ac sources and have built-in

loudspeakers.
Ranges: 30-50 mc FM, 112-132 mc AM, 132-154 mc AM, 154-174 mc FM. Crystal controlled models available.

UHF TUNABLE CAVITY FILTER
Mfr.: Granger Associates
Model: UF-2
Size: ½ ATR
Weight: 13 lbs.
Remarks: 225-400 mc; bandwidth 1 mc; Selectivity 40 db rejection. For aircraft on ground operation of two or more UHF transmitter-receivers on one antenna.

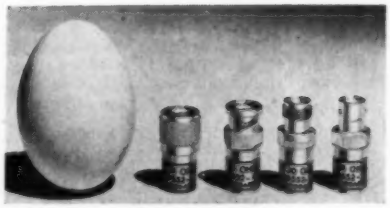


DOPPLER NAVIGATOR
Mfr.: General Precision Laboratory, Inc.
Remarks: Lightweight RADAN navigator occupies 4.4 cu. ft. Provides ground speed and drift angle. Ground speed error is less than 1%, drift angle error less than 0.5°. Functions to 70,000 feet. Weight, 89 lbs.

TRANSISTORIZED COMPUTER
Mfr.: Ramo-Wooldridge Corp.
Remarks: RW-300 digital computer for scientific and engineering data processing. General storage of 7,936 words, 16 words of fast-access storage in a 16-word circulating register. Access time is 8.3 ms. Modular construction.

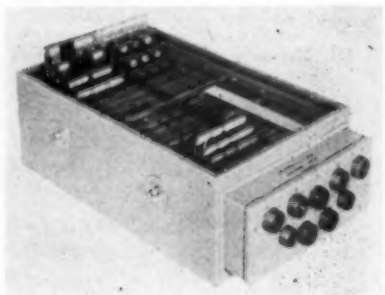
VHF CONTROL HEADS
Mfr.: Transval Engineering Corp.
Remarks: Small, edge-lighted remote control heads for VHF radio equipment. Measures 2⅝" x 2" and weighs less than ¾ lb. Incorporates on-off switch, volume control and channel selector.

POWER TRANSISTOR
Mfr.: General Electric Co.
Model: 2N451
Remarks: New silicon power transistor dissipates 85 watts at 25°C. Nominal collector saturation resistance is 2 ohms. Max. collector current is 5 amps.



COAXIAL TERMINATION
Mfr.: Stoddart Aircraft Radio, Inc.
Model: BNC or TNC
Size: 1/16" dia.
Ratings: VSWR less than 1.2 to 1,000 mc. Impedance 50 ohms, voltage 100
Remarks: Gold-plated electrical contacts and platinum film resistors on ceramic.

TRANSAC AIRBORNE COMPUTER
Mfr.: Philco Corp.
Model: C-1100
Size: Less than 4 cu. ft.



Weight: 16 lbs.
Remarks: Uses 3,000 transistors. Computes navigation and flight control problems each 1/60th second.

Other product sources

Antennas—Dittmore-Freimuth Corp.; navigation and radar equipment and radomes.
Antennas—ITE Circuit Breaker Co., Special Products Div.; airport surveillance; shipboard search, missile-tracking radar antennas.
Antennas—Mark Products Co.; parabolic, for relay applications, monopole and array types.
Breadboard kits—PIC Design Corp., Benrus Watch Co., Inc.; missile computer test gear.
Cable—Spectra-Strip Div., Organic Development Corp.; multi-conductor, multi-colored cable, flat construction.
Capacitors—Sprague Electric Co.; subminiature and standard fixed paper or paper film types.
Capacitors—Vitramon, Inc.; axial radial design for aircraft and missiles.
Communication and navigation systems—National Aeronautical Corp.; complete

Product data – electronics

Item	Manufacturer	Model	Dimensions	Weight (lbs.)	Ratings	Remarks
Altimeter, radar	Radio Corp. of America	AVQ-9A		27.7	Power required 120va, 115 vac	Improved version of AVQ-9. High range 60,000 ft.
Amplifier, audio	Transval Engineering Corp.	TCA-10	7" x 3" x 3"	3½	Power output 10 watts; speaker impedance 4, 8, or 16 ohms; primary power 28 volts dc; input impedance 125 or 500 ohms	Transistorized cabin or isolation amplifier. Up to 20 isolated inputs can be provided.
Amplifier, high power distributed	Instruments for Industry, Inc.	M-400	19" x 16¼" x 8"	32	200kc to 300mc, 10 db gain	Power output 100 watt cw.
Amplifier, IF	Instruments for Industry, Inc.	M-200 series	15" x 1½" x 1½"	5	30mc & 60mc band center, 90-110 db gain	50 ohm input & output.
Amplifier, IF	Lel, Inc.	80B	8" x 2¼" x 1½"	4.1	Transistorized, ruggedized, subminiature	Missiles, radar missile.
Amplifier, IF	Lel, Inc.	64D			Transistorized, ruggedized, subminiature	Missiles, radar missile.
Amplifier, intercom	Transval Engineering Corp.	7003	3" x 2" x 2"	½	Input & output impedance 300 ohms; dc input less than 0.1 amp. at any voltage 6-28 volts	Used in intercom systems where weak line signals or high noise levels exist. Jet test positions, rocket firing range, etc.
Amplifier, narrow-band pre-amplifier	Arenberg Ultrasonic Lab., Inc.	PA620	5" x 4" x 3"			For radar and other pulse system test equipment 0-100 mc range.
Amplifier, strain gauge	James S. Spivey, Inc.	10A	1¾" x 1⅞" x ½"	1.1 oz.	Gain 200, input 25 mv @ 120 or 350 ohms to 500,000 ohm load; linear dc to 50kc	Strain gauge amplifier.
Amplifier, super video	Instruments for Industry, Inc.	M-395	can be rack mounted 13" x 8" x 10¾"	35	1 kc to 50 mc, 70 db gain	Amplifier signals as low as 70 microvolts.
Amplifier, wide-band	Arenberg Ultrasonic Lab., Inc.	WA600	19" x 11" x 8¾"	45	Flat 5-65 mc, 90 db gain	For radar and other pulse system test equipment; 0-100 mc range.
Amplifier, wide-band	Instruments for Industry, Inc.	M-530	19" x 16" x 9"	12	10 kc to 300 mc, 18 db gain	Voltage amplification of CW or pulsed signals.
Amplifier, wide-band	Instruments for Industry, Inc.	M-500A	13½" x 4⅜" x 2⅝"	12	200 kc to 220 mc, 12 db gain	3 watt CW output. Used as linear or pulse amplifier.
Amplifier, wide-band	Instruments for Industry, Inc.	M-510	13" x 4⅜" x 2⅝"	10	200 kc to 220 mc, 16 db gain	Supplies 3 watt CW output.
Antenna	Communications Co., Inc.	130	various		25-50mc, 152-174mc, 118-132 mc, 132-144 mc	Aircraft
Antenna loading unit, automatic	Transval Engineering Corp.	TLU-6	12" x 5½" x 7"	5	Primary power 14 or 28 vdc; range: selects any 6 frequencies in 2 to 12 mc range	No rotating coils, electric motors or tubes.
Antenna tuning unit	H. J. Burke Co.	SA22	9¾" x 9½" x 9¼"	10	RF generator	Airborne.
Antennuator, calibrated	Arenberg Ultrasonic Lab, Inc.	ATT-693	12" x 2" x 1½"	4⅞	0-122 db range, 50-75-93 ohm terminations	For radar and other pulse system test equipment; 0-100 mc range.
Automatic pilot	Mitchell Industries, Inc.		3 unit	8.2	3-directional control, 1/10 amp at 12 volts	All-transistorized low-cost system; CAA approved.
Beacon, homing	Sperry Gyroscope Co., div. Sperry Rand Corp.	APN-69				Tanker plane locator.
Calorimeter, rf	Chemalloy Electronics Corp.	SME	14" x 9" x 9"	20	0-500 watts avg., 0-5 million watts peak from 100 to 40,000 mc	Radar energy measurement.
Camera, television	Allen B. DuMont Laboratories, Inc.		subminiature		Vidicon, viewer, camera control, and amplifier chassis; 600 line resolution; 115v, 400 cps	For military airborne use.
Capacitors, high stability glass-to-metal sealed	Electron Products Co.	PS 200	1" od x 2⅛"	0.12	1 mfd, 200 vdc (125°)	Capacity variation less than 1% from —55°C to +125°C.
Capacitors, rectangular, tubular, glass-to-metal sealed	Electron Products Co.	Style G	volume 30% less than standard tubulars	20% less than std. tubulars	Values equivalent to all types of standard tubulars	Hermetically sealed (MIL-C-25A) for —55°C to +150°C; metallic, paper, Mylar, conventional.
Capacitors, metallized	Electron Products Co.	M 150			All values to 10 mfd, 600 vdc	Moisture-proof (MIL-C-91A), for —55°C to +125°C self-sealing operation.
Clock, atomic	National Co., Inc.	NC-1001	22" x 18" x 84"	500	Stability: 5 parts in 10^{10}	Frequency std; airborne and ground.
Clock, atomic	National Co., Inc.	NC-1101	22" x 18" x 60"	400	Stability: 1 part in 10^{9}	Frequency std; airborne and ground.
Computer, navigation	Ford Instrument Co., div. Sperry-Rand Corp.	ASN-7	1.077 cu.ft.	67.15	70-2,000 knots, 1,000 miles (one leg), 0-180° E&W, 0-200° wind force, 360° wind direction	Developed for WADC. Miniaturized, transistorized amplifiers.
Control system for tape recorders	Electronic Engineering Co.	ZA14162	rack			Locates information on tape recording; automatic.
Crystal, quartz	Edison Electronic Co.				Standard—all types	Frequency control of radio transmitters and receivers.
Data converter, analog to digital	Itnl. Tele. & Tele. Corp., Industrial Products Division		2 11/16" long	8 oz.	Binary coded decimal readout with resolution of 10 per shaft revolution	Modular construction enables assembly of units which encode any quantity, time, count, degrees, latitude, and longitude.
Data converter, analog to digital	Jones & Wettlaufer Engrg. Corp.	C 4	1¾" x 1¾" x 5"	1.0	Brush contact	Shaft rotating, decimal; 1 count per rev.
Data converter, analog to digital	Jones & Wettlaufer Engrg. Corp.	C3-10	1¾" x 1¾" x 4¼"	0.8	Brush contact	Shaft rotating, decimal; 10 counts per rev.
Data converter, analog to digital	Jones & Wettlaufer Engrg. Corp.	PI	2½" x 2½" x 3¾"	0.9	Photo transducer	Shaft rotating, incremental pulsing.
Diplexer, radio frequency	Budelman Radio Corp.	149	19" x 3½" x 7½" dia.	5	Frequency range 450-470 mc, 890-960 mc	Provides coupling of transmitter and receiver to one antenna.
Flight director system	Collins Radio Co.	FD-105	4" instruments	23.0		Improved presentation.

Product data – electronics *(Continued)*

Item	Manufacturer	Model	Dimensions	Weight (Lb..)	Ratings	Remarks
Generator and power supply	Packard-Bell Electronics Corp.	LS-10 CX-D	10" x 7" x 6" (2 units)	23	Pulse time intervals of 0.001 to 1 sec.	For airborne motion picture timing marks on film; also as frequency time standard.
Generator, timing	Philco Corp.		0.65 cu.ft.	16	8 pulse outputs in sequence	For U.S. Navy airborne radar transmitter operation.
Inverter, transistor, dc to ac	Varo Mfg. Co., Inc.	430IC	5.7" x 3" x 3.6"	3.5	28 vdc input to 115 vac, 400 cps ±0.1%; three-phase	Missile and aircraft.
Isolator, microwave ferrite	Cascade Research Corp.	X-125	1" x 2" x 3"		Frequency 8.5-916kmc, peak power 100 kw, power average 100 watts, isolation 10 db, insertion loss 1.0 db	Aircraft radar, missile guidance.
Miss-distance indicator system	The Ralph M. Parsons Company	PARAMI			Records radial separation of missile and target to 3,000 ft. in 10 ft. steps	Antenna, missile, transponder, ground recording system.
Modular induction	Weston Elec. Inst. Corp.	1408	2¾" x 1⅛" x 1½"	0.3	0.5 ma, 115 v 400 cps	Missiles.
Navigation aid	Federal Telephone & Radio Co.		19½" x 7½" x 4⅞"	35	VOR/Tacan-DME	Airborne system.
Navigation converter	National Aeronautical Corp.	VOA-3	4" x 5" x 6"	3.3	VOR or localizer	Crystal-controlled.
Oscillator, high powered pulsed	Arenberg Ultrasonic Lab., Inc.	PG650	12" x 9" x 21"	55	300 v peak to peak	For radar and other pulse system test equipment.
Oscillator sub-carrier	James S. Spivey, Inc.	55A	3⅜" x 1 15/16" x 1 7/16"	0.29	All IRIG frequencies and deviations	Telemetering.
Oscilloscope	James S. Spivey, Inc.	85A	19" x 7" x 20"	15	dc to 100 kc balanced or unbalanced input	For fixed-station radio teletypewriter monitoring and adjustment.
Oscilloscope	Allen B. DuMont Laboratories, Inc.	410			dc to over 50 mc; repetition rate 250 kc	Wide-range scope uses block packaging for unit interchangeability to alter performance.
Potentiometer, pressure	Edcliff Instruments	2-B-2	2" x 3" dia.	12 oz.	From 0-150 psi to 5,000 psi A, D or G	For missiles and aircraft.
Power supply, high voltage regulated	Transval Engineering Corp.	5001	5" x 4" x 4½"	3½	Primary power 109 to 121 v, output 1,050 ±5 vdc; ripple 0.01% of output, regulation 0.5% with nominal load	Used in missile application where hermetically sealed unit required.
Power supply, multiple voltage high power transistorized	Transval Engineering Corp.	5010	30" x 20" x 7"	45	Output power +300 vdc at 250 ma; —150 vdc at 600 ma, +150 vdc at 2.0 amps; input 120v, 60 cps	Developed for ground system to provide 16 highly stable high power dc supplies.
Power supply, multiple voltage high power transistorized	Transval Engineering Corp.	5029	30" x 20" x 7"	45	Output power +28 vdc at 2.5 amps, +1.5 vdc at 1.75 amps, —6.0 vdc at 1.5 amps, —7.5 vdc at 1.0 amps, —28 vdc at 5.0 amps; input 120v, 60 cps	Developed for ground system to provide 16 highly stable high power dc supplies.
Power supply, multiple voltage high power transistorized	Transval Engineering Corp.	5053	30" x 20" x 7"	45	Output power +130 vdc at 100 ma; —150 vdc at 250 ma, +150 vdc at 600 ma; input 120v, 60 cps	Developed for ground system to provide 16 highly stable high power dc supplies.
Power supply, multiple voltage high power transistorized	Transval Engineering Corp.	5054	30" x 20" x 7"	45	Output power +28 vdc at 1.0 amp, +1.5 vdc at .5 amp, —6.0 vdc at .4 amp, —7.6 vdc at .5 amp, —28 vdc at 2.0 amp; input 120v, 60 cps	Developed for ground system to provide 16 highly stable high power dc supplies.
Power supply, semi-militarized missile check out and launching dc	Perkin Engineering Corp.	M675	17" x 19" x 28"	275	24-32 v @50 amp	
" "	Perkin Engineering Corp.	M675-1	17" x 19" x 28"	275	24-32 v @100 amp	
" "	Perkin Engineering Corp.	M676	14" x 19" x 21"	180	24-32 v @30 amp	
" "	Perkin Engineering Corp.	M677	22" x 22" x 46"	650	24-32 v @200 amp	
" "		M678	22" x 22" x 46"	750	24-32 v @300 amp	
Power supply, silicon	Rapid Electric Co.		42" x 22" x 20"	250	ac input 440 v, 3-phase, 60 cyc; dc output 30 amps, 50 v	dc control circuits test guided missiles.
Power supply, silicon rectifier	Sanford Miller Co.	SI-BR	6" x 6" x 6"	1¼	Various voltages, up to 80 amps.	For bench testing electronic equipment or battery charging.
Power supply, subminiature	Land-Air, Inc.	128A	9" x 1" x 3"	2¼	160 vdc at 100 ma, 6.3 vac at 5 amp.	Aircraft and missile use.
Power supply, transistor-regulated, precision	Transval Engineering Corp.	5000 series	various	various	Power output up to 2.5 kva, dc voltage 1 v to 2.5 kv, current 0-20 amp.; regulation 0.05%, stability 0.01% for 24 hrs., ripple 0.002%	Used in aircraft, ground systems, radar systems, instrumentation requirements where close voltage regulation is needed.
Power supply, transistor-mag. amp.	Perkin Engineering Corp.	MTRO 60-5	12" x 19" x 10½"	85	0-60 v @ 5 amp.	Newly designed to latest transistor-mag. amp. regulating techniques.
Power test unit, missile ground	Varo Mfg. Co., Inc.	2615			440-v, 3-phase, 60 cps. input to 115/208 v, 3-phase output	Missile power test system.
Radar, airborne	Sperry Gyroscope Co. div. Sperry Rand Corp.	APN-59	18" reflector 30" reflector	174½ 182	Variable range 3 to 30 miles. Fixed Range 50, 100 & 240 miles; 12 rpm; freq. 9,375 mc	Navigation, mapping, beacon interrogation, weather.
Radar, weather	Radio Corp. of America	AVQ-10	Two 1 ATR units	125	Power required 875 va, 115 vac, 30 watts, 28 vdc.	Ranges 20, 50 & 150 miles; has echo contour circuitry.
Radar, weather	Radio Corp. of America	AVQ-50	Two short ¾ ATR units	50	Power required 195 va, 115 v, 1.7 watts dc; power output 1000 watts	Ranges 20 & 30 miles; indicator mounts in standard 3½" instrument panel; also available in 5". Reflector size 12, 15 & 18".
Radio FM point-to-point	Budelman Radio Corp.	14BW	19" x 21" x 7"	52	Frequency range 890-960 mc, power output 2 watts	For point-to-point radio circuits carrying up to 10 frequency-division multiplexed voice channels and one service channel.

Product data – electronics *(Continued)*

Item	Manufacturer	Model	Dimensions	Weight (Lbs.)	Ratings	Remarks
Radio telephone	Communications Co., Inc.	278	13" x 11" x 6½"	30	3-4 watts output; 118-132 or 132-152 mc	Ground support, VHF-AM vehicular equipment.
Receiver, airport	Communications Co., Inc.	278-S ARE			118-132 or 132-152 mc	Ground support, VHF airport receiver.
Receiver, Communication, VHF	Collins Radio Co.	51X-2	12 9/16" x 3 9/16" x 7⅞"	10.5	880 channels	Aircraft receiver.
Receiver, navigation	" "	344B-1	12 9/16" x 3 9/16" x 7⅞"	12.0	Complete VOR-ILS instrumentation	Available combined with 51X-2; type No. 51R-4.
Receiver, subminiature	Land-Air, Inc.	129A	RF9" x 1" x 3" IF9" x 1" x 3"	5	5 milliwatt, 3 lb., 100-30,000 cps. fm & am, 40-200 mc systems	Aircraft or missile monitoring.
Receiver, transistorized marker	Radio Corp. of America	AVR-200	short ¼ ATR	4.0	Power required 35 ma @ 28 vdc or less than 2va @ 115 VAC	No moving parts. No change in power supply for ac or dc operation.
Receiver-transmitter	Communications Co., Inc.	400	4" x 11½" x 6½"	16	25 watts output 25-50 mc; 15 watts output 152-174 mc	Aircraft—VHF-FM.
Receiver, transmitter, MHF	Transval Engineering Corp.	Mark IV	12¾" x 5" x 7 11/16"	12	Frequency 2-10 mc; trans. output 35 watts; audio output 10 watts; stability 0.005%	Transistorized power supply, transmitter, receiver in one short ½ ATR rack.
Recorder & producer, magnetic tape	Consolidated Electrodynamics	5-752			14 channels; analog PDM & FM signals on tape; 0 cycles-100kc frequency range; tape speeds 1⅞ to 60 ips	For telemetry recording in wind tunnel, engine tests, etc.
Relay-time delay	G. C. Wilson & Co.	EHS	2" x 2" x 3"	½	1 amp. @ 24 v	For rocket engine safety control.
Resistors, miniature oval	Milwaukee Resistor Co.	5%	⅜" x ⅜" x ⅞" 9/16" x 1" ⅝" x 1"		10 watts 15 watts 20 watts	Compact, light weight, withstand high g.
Simulators, training	ERCO Div., ACF Industries, Inc.					For F86D, F9F, RB-66B, P2V-5, KC-135, F4D-1, PSM-1, AD-5N aircraft training.
Switchmaster	National Aeronautical Corp.	VP-8A	3" x 1" x 5"	¾	Audio and transmitter integrating & switching panel	For light aircraft.
Solder, fluxless aluminum	Chemalloy Electronics Corp.		various	various	500° to 800° F versions	
Thyratron, Xenon	Vacuum Tube Products Co., Inc.	VTP-6991	5⅛" x 1⅞"			Guaranteed 500 hour tube for aircraft inverters.
Transmitter, VHF communication	Collins Radio Co.	17L-7	12 9/16" x 3 9/16" x 7⅞"	14.0	680 channels, 25 watts output	Aircraft.
Transmitter, VHF communication	Collins Radio Co.	17L-8	3¾" x 3¾" x 8⅝"	2.5	90 chan., 3 watts output	Aircraft.
Transponder, air traffic control	Radio Corp. of America	AVQ-60	½ ATR	25	Power required 195 va, 115 v, & 1.7 watts dc; power output 1,000 watts	Conforms to Arinc characteristic No. 532-A; 64 code combinations.
Trigger, Philco electronic	Philco Corp., Govt. & Industrial Div.		0.65 cu. ft.	16		For sequential triggering and timing of up to 8 operations—as a radar control unit, communications coordinator, test device coordinator.
Tube, storage	Vacuum Tube Products Co., Inc.	VTP-6991	5" x 13½"			For radar display.
Tube, storage	Vacuum Tube Products Co., Inc.	VTP-6992	3" x 10½"			For radar display.
Tube, traveling wave	Intl. Tele. & Tele. Corp., Components Div.	F-66 58	11½" x 1 11/16"	1 7/16	1250 v, 1-watt output, 3,000 mc center frequency	For ECM use. All metal helical type, 2,000-4,000 mc range.
VHF comm. transmitter	National Aeronautical Corp.	VTA-3	1 9/16" x 6¼" x 6¼"	1¼	27-channel VHF transmitter	For light aircraft.
VHF transmitter, receiver	National Aeronautical Corp.	1016	½ ATR	24.7	360 channels trans. 560 channels rec.	For civil, military, airline aircraft.
Vibrator, transistorized replacement	Transval Engineering Corp.	VR-9	2 11/16" x 2¼" x 3¾"	less than 1 lb.	12 v, switches up to 9 amps; operates both transmitter & receiver, no moving parts, operates from positive or negative sources	All mobile radio equipment where vibrators are used.

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airborne equipment for business and private aircraft.

Computer—M. Ten Bosch, Inc.; unit measures air speed, altitude, and air density.

Connectors—Gremar Mfg. Co., Inc.; rf connectors, TNC, captivated contact, aluminum types.

Data converter—Epsco, Inc.; airborne voltage-digital, 50,000 conversions per sec.

Magnetic amplifiers—Engineered Magnetics Div., Gulton Industries, Inc.; mag. amp. power supplies, transistorized dc voltage transformers, strain gauge power supplies.

Magnetic amplifiers—Magnetic Amplifiers, Inc.; controllers for low-power hydraulic servo valves.

Magnetic tape—Reeves Soundcraft Corp.; computer, telemetering, video recording tape ¼ to 2".

Microphone—Universal Microphone Co.; ½ lb. carbon type for aircraft.

Power converter—Southwestern Industrial Electronics Co.; transistorized converters and magnetic amplifiers.

Power supply—Adler Electronics, Inc.; Model 9456 for missile testing.

Relays—Electronic Specialty Co.; electronic time delay and repeat cycle timers.

Relays—Reltron Corp.; subminiature for continuous duty to 200°C.

Relays—M. H. Rhodes, Inc.; mark-time delay relays.

Resistors—RCL Mfg. Co.; wire-wound resistors.

Sensors—Voltage & Frequency Electronic Specialty Co.; frequency range 200-1,000 cps.

Slotted lines—ITE Circuit Breaker Co., Special Products Div.; slotted sections with probe and carriage.

Terminations—ITE Circuit Breaker Co., Special Products Div.; terminations and short-circuit sections of aluminum.

Thermistors, varistors, resistors—Globar Div., The Carborundum Co.; subminiature resistors, negative temperature resistors, bridges.

Waveguides—ITE Circuit Breaker Co.; large, for multi-megawatt radar and scatter communication equipment.

Directory of manufacturers

For additional information on products listed in this section, write to manufacturers at address below, attention Sales Manager. Give page number and refer to AMERICAN AVIATION ENGINEERS HANDBOOK of new products.

ACF Industries, ERCO Div., P.O. Box 209, Hyattsville, Md.

Frank Adam Electric Co., P.O. Box 357, Main Post Office, St. Louis, Mo.

Advanced Products Co., The, 59 Broadway, North Haven, Conn.

Adler Electronics, Inc., 1 Le Feure Lane, New Rochelle, N. Y.

Aircraft Radio Corp., Boonton, N. J.

American Machine & Foundry Co., Turbo Div., 10446 Glenoaks Blvd., Pacoima, Calif.

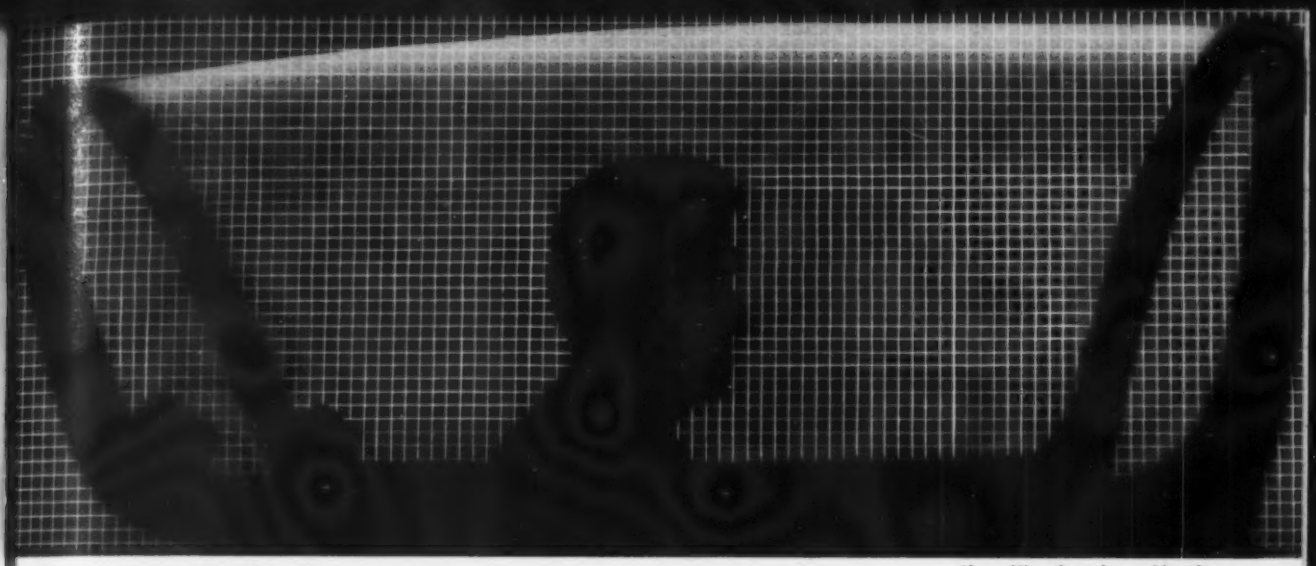
Arenberg Ultrasonic Laboratory, Inc., 94 Green St., Jamaica Plain 30, Mass.
B & F Instruments, Inc., 4732 No. Broad St., Philadelphia 41, Pa.
Bendix Aviation Corp., Red Bank Div., Eatontown, N. J.
Bendix Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md.
M. Ten Bosch, Inc., Pleasantville, N. Y.
British Industries Corp., 80 Shore Rd., Port Washington, N. Y.
Budelman Radio Corp., 375 Fairfield Ave., Stamford, Conn.
H. J. Burke Co., 49 Washington Ave., Little Ferry, N. J.
Carborundum Co., The, Globar Div., Niagara Falls, N. Y.
Cascade Research Corp., 53 Victory Lane, Los Gatos, Calif.
Chemalloy Electronics Corp., Santee, Calif.
Cline Electric Mfg. Co., Aircraft Products Div., 3405 W. 47th St., Chicago 32, Ill.
Collins Radio Co., 855 35th St., N.E., Cedar Rapids, Iowa
Communications Co., Inc., 300 Greco Ave., Coral Gables, Fla.
Computer Measurements Corp., 5525 Vineland Ave., North Hollywood, Calif.
Consolidated Electrodynamics Corp., 300 North Sierra Madre Villa, Pasadena, Calif.
Consolidated Electrodynamics Corp., Rochester Div., 1775 Mt. Read Blvd., Rochester, N. Y.
Cubic Corp., 5575 Kearny Villa Rd., San Diego 11, Calif.
James Cunningham, Son & Co., Inc., P.O. Box 516 Zone 2, Rochester 8, N. Y.
Curtiss-Wright Corp., Industries & Scientific Products Div., P.O. Box 270, Caldwell, N. J.
Daystrom, Inc., Daystrom Instrument Div., Archbald, Pa.
Daystrom, Inc., Daystrom Pacific Corp., Santa Monica, Calif.
DIT-MCO, Inc., Electronics Div., 911 Broadway, Kansas City 5, Mo.
Dittmore-Freimuth Corp., 2517 E. Norwich St., Milwaukee 7, Wisc.
Donner Scientific Co., 2829—7th St., Berkeley 10, Calif.
Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.
Dynamic Instrument Co., 28 Carleton St., Cambridge 42, Mass.
Edcliff Instruments, 383 N. Foothill Blvd., Pasadena, Calif.
Eidson Electronic Co., 1902 No. Third St., Temple, Tex.
Electro Products Laboratories, 4501 N. Ravenswood Ave., Chicago 40, Ill.
Electro Snap Switch & Mfg. Co., 4218 W. Lake St., Chicago 24, Ill.
Electron Products Co., 430 No. Halstead St., Pasadena, Calif.
Electronic Engineering Co. of Calif., 1601 E. Chestnut Ave., Santa Ana, Calif.
Electronic Specialty Co., 5121 San Fernando Rd., Los Angeles 39, Calif.
Epsco, Inc., 588 Commonwealth Ave., Boston 15, Mass.
Federal Telephone & Radio Co. Div., International Telephone & Telegraph Corp., 100 Kingsland Rd., Clifton, N. J.
Ford Instrument Co. Div., Sperry Rand Corp., 31-10 Thomson Ave., Long Island City 1, N. Y.
The Garrett Corp., AiResearch Mfg. Co. of Arizona Div., 402 So. 36th St., Phoenix, Ariz.
General Electric Co., Schenectady 5, N. Y.
General Precision Laboratory, Inc., subsidiary of General Precision Equipment Corp., 63 Bedford Rd., Pleasantville, N. Y.
Granger Associates, 966 Commercial St., Palo Alto, Calif.
Gremar Mfg. Co., Inc., Wright St., Lynn, Mass.
Gruen Precision Laboratories, Div., Gruen Industries, 9701 Reading Rd., Cincinnati 15, Ohio
Gulton Industries, Inc., Engineered Magnetics Div., 11818 Teale St., Culver City, Calif.
Heath Co., Benton Harbor, Mich.
I-T-E Circuit Breaker Co., Special Products Div., 601 E. Erie Ave., Philadelphia 34, Pa.
Instruments for Industry, Inc., 150 Glen Cove Rd., Mineola, N. Y.
International Telephone & Telegraph Co., Components Div., 100 Kingsland Rd., Clifton, N. J.
Jones & Wattlaufer Engrg. Corp., 11780 W. Pico Blvd., West Los Angeles 64, Calif.
Land-Air, Inc., 744 Wilson Ave., Chicago, Ill.
Lear, Inc., Learcal Div., 3171 So. Bundy, Santa Monica, Calif.
Lel, Inc., 390 Oak St., Copiague, N. Y.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
Mark Products Co., 6412 W. Lincoln Ave., Morton Grove, Ill.
Sanford Miller Co., Brooklyn 6, N. Y.
Milwaukee Resistor Co., 700 W. Virginia St., Milwaukee 4, Wisc.
Mitchell Industries, Inc., P.O. Box 17, Mineral Wells, Tex.
National Co., Inc., 61 Sherman St., Malden 48, Mass.
National Aeronautical Corp., Commerce Dr., Ft. Washington, Pa.
Norden-Ketay Corp., Commerce Rd., Stamford, Conn.
Organic Development Corp., Spectra-Strip Div., 10052 Larson Ave., Garden Grove, Calif.
Packard-Bell Electronics Corp., 12333 W. Olympic Blvd., Los Angeles 64, Calif.
Ralph M. Parsons Co., The, Electronics Div., 151 So. De Lacey Ave., Pasadena, Calif.
Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.
Philco Corp., Government & Industrial Div., 4700 Wissahickon Ave., Philadelphia 44, Pa.
Radio Corp. of America, West Coast Electronic Products Dept., 11819 W. Olympic Blvd., Los Angeles 64, Calif.
Rapid Electric Co., 2881 Middletown Rd., New York 61, N. Y.
Ramo-Wooldridge Corp., 5500 W. El Segundo Blvd., Los Angeles 45, Calif.
R. C. L. Mfg. Co., Riverside, N. J.
Reed-Curtis Nuclear Div., American Electronics, Inc., 655 W. Washington Blvd., Los Angeles 15, Calif.
Reeves Soundcraft Corp., 10 E. 52nd St., New York 22, N. Y.
Reltron Corp., 282 Centre St., Newton 58, Mass.
M. H. Rhodes, Inc., 30 Bartholomew Ave., Hartford, Conn.
Rototest Laboratories, Inc., 2803 Los Flores Blvd., Lynwood, Calif.
Arthur C. Ruge, Inc., 733 Concord Ave., Cambridge 38, Mass.
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., P.O. Box 13058, Houston, Tex.
Sperry Gyroscope Co., Div., Sperry Rand Corp., Great Neck, N. Y.
James S. Spivey, Inc., 4908 Hampden Lane, Washington 14, D. C.
Sprague Electric Co., North Adams, Mass.
Tensitron, Inc., Harvard, Mass.
Transval Engineering Corp., 10401 W. Jefferson Blvd., Culver City, Calif.
Universal Microphone Co., Box 55, Inglewood, Calif.
Vacuum Tube Products Co., Inc., 2020 Short St., Oceanside, Calif.
Van-Dee Products, 300 Ocean Ave., Laguna Beach, Calif.
Varo Mfg. Co., Inc., 2201 Walnut St., Garland, Tex.
Vitramon, Inc., Bridgeport 1, Conn.
Waterman Products Co., Inc., 2445 Emerald St., Philadelphia 25, Pa.
Wilcox Electric Co., Inc., 14th & Chestnut, Kansas City 27, Mo.
G. C. Wilson & Co., Huntington, W. Va.

Product data – electrical accessories

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Actuator-90° rotating	Gray & Huleguard Inc.	510	5.8" x 3.5" x 3.9"		115 vac-400c 2 phase output; stall torque-50 in-lb.	For "Snark" missile
Actuator-1200° rotating	" " " "	511	6.3" x 3.5" x 4.2"	2.8	115 vac-400c 2 phase output; stall torque-50 in-lb.	For "Snark" missile
Alternator	" " " "	278-050	6.7" x 7.5" dia.	26.0	115/200 v 2.5 kva 3 phase 400c & 10-A-28v dc	Emergency power unit on F8U
Battery, silver-zinc	Frank R. Cook Co.	P3A	7" L x 7" dia.	10.8	360 v output at 125 ma; 200v at 350 ma; 6082 at 20 amps; 135v at 100 ma.	Auto-actuated; output furnished within 0.8 secs. after activation for 45 secs. duration 362 cells
Battery, silver-zinc	" " " "	P8B	8.75" x 2.5" x 3.375"	3.1	28v at 15 amps; duration 5 mins.	20 cells
Battery, silver-zinc	" " " "	P11A	6" x 5.69" x 5.62"	7.0	28v at 50-90 amps. duration five mins.	20 cells
Battery, silver-zinc	" " " "	SC-05	0.82 cu. in. volume	0.04	0.5 amp/hr. capacity; max. 10 amps.	Secondary (storage) battery
Battery, silver-zinc	" " " "	SC-3	3.66 cu. in. volume	0.21	3 amp/hr. capacity; max. 50 amps.	" " "
Battery, silver-zinc	" " " "	SC-18	14.5 cu. in. volume	0.80	18 amp/hr. capacity; max. 160 amps.	" " "
Battery, silver-zinc	" " " "	SC-40	32 cu. in. volume	1.5	40 amp/hr. capacity; max. 230 amps.	" " "
Brake	Autotronics, Inc.	B	1" x .50" dia. to 1.7" x 1.25" dia.	.7 to 7.4 oz.	Brake-4 to 60 oz. in torque min.	Electronic & instrument applications
Brake-magnetic	Lyndon Aircraft, Inc.	1041	4.1" x 3" x 1.85"	1.25	Withstands 200 in. lbs. torque, min. Freely rotates under 3 in. lbs. torque, max.	Used in aircraft flight control system
Bus assemblies	Janco Corp.			0.1	1½" lgth. and ap; No. 6 hole to ⅜" dia.	Switches, circuit breakers, fuse blocks, etc.
Canopy actuator electro-mech/ pneumatic	Gray & Huleguard Inc.	524	45" x 4.2" x 10"	29.5	300 lb. T or C load 36 in. stroke 26vdc; pneumatic ejection feature	Canopy actuator T2-J
Clutch	Autotronics Inc.	C	1.1" x .5" dia. to 2" x 1.25" dia.	.8 to 7.4 oz.	Clutch-3.5 to 56 oz. in. torque min.	Mechanical clutch for servo system
Clutch-2 way brake	" "	MBC	1.4" x .5" dia. to 2.5" x 1.25" dia.	1.0 to 9.2 oz.	Brake-2 to 30 oz. in. torque min. Clutch-2 to 30 oz. in. torque min.	Speed or direction changer in servo system
Clutch brake	" "	MC	1.1" x .5" dia. to 2" x 1.25" dia.	.8 to 7.5 oz.	Clutch-2 to 32 oz. in. torque min. Brake-2 to 32 oz. in. torque min.	Mechanical switch for a servo system
Clutch brake	" "	MB	1.1" x .5" dia. to 2" x 1.25" dia.	.8 to 7.5 oz.	Brake-2 to 30 oz. in. torque min. Clutch-2 to 30 oz. in. torque min.	Servo system instrument
Clutch-duplex	" "	MCC	2" x .5" dia. to 3.7" x 1.25" dia.	1.8 to 15 oz.	Clutch-3.5 to 56 oz. in. torque min.	Speed or direction changer in servo system
Connector	Aircraft Controls Co.	GPCP23 M7F	3½" long		23 contacts	NAS std. 1/10 grid spacing.
Connectors, high altitude	Consolidated Electrodynamics Corp.	100, 200, 300, 400			1,800 vac (sea level)	Miniature for high altitude aircraft and missiles
Generator-AC	Leland Aircraft Products	AGE-41-2	11½" x 7½" x 10 3/16"	31.4	5.0 kva output, 120-208v, 3 phase, 6,000 rpm	Aircraft
Generator-AC	Leland Aircraft Products	AGE-46-3	7 5/16" dia. 6⅛"	17.4	5.0 kva output, 115-200v, 3-phase 24,000 rpm	Missile
Generator-AC	Leland Aircraft Products	AGE-53-1	7½" x 6⅛" x 7⅛"	17.5	3.3 kva output 120-208v 3-phase, 12,000 rpm	Aircraft
Generator, synchronous	Land Air, Inc.	101	3.5" x 2¼" x 2¼"	1.5	2 pole-3 phase @ 1700 rpm approx. 23 watts	Standard drive by tachometer pads
Instrument translator	Crescent Engineering & Research Co.	T-582	2.5" x 2.9" x 1/4"	9 oz.	1 watt power requirement-65 to 250°F.	For servo systems. Makes possible use of ac transducers where only dc is available
Inverter	Leland Aircraft Products	SE-7-1	14 8/16" x 7⅛" x 10 13/16"	55.5	750va-single-phase-115v-60 cycle	Aircraft
Inverter	" "	SE-15-2	13 5/16" x 7 3/16" x 9½"	41.2	1500va-single-phase-115v-400 cycle	Aircraft
Inverter	" "	SE-16-3	9 9/16" x 4 9/16" x 7 11/32"	14.6	250va-one and 3-phase-115v-400 cycle	Aircraft & missiles
Inverter	" "	MGE-22-1	11 13/16" x 7 5/32" x 9 23/32"	33.5	750va-one and 3-phase-115v-400 cycle	Aircraft & missiles
Inverter	" "	MGE-23-1	13 15/16" x 7⅛" x 9½"	44.5	2500va-one and 3-phase-115v-400 cycle	Aircraft & missiles
Inverter	" "	SE-24-1	13 3/8" x 7⅛" x 9¼"	41.0	2250va-single-phase-115v-400 cycle	Aircraft & missiles
Inverter	" "	MGE-31-2	13⅜" x 7⅛" x 9½"	46.5	2800va 3 hrs. continuous 2500va single phase, 115v, 400 cps	Aircraft & missiles
Jumpers-electrical	Janco Corp.			0.1	6,000 cma & greater	Electrical bonding applications
Magnetic amplifier	Dynamic Research Associates, div. Univ. Match Corp.	MA-41	3½" x 2" dia.	11 oz.	400 cps, 115v 62 mw output	For strain gauge, thermo-couple for dc instrument use

Product data - electrical accessories *(Continued)*

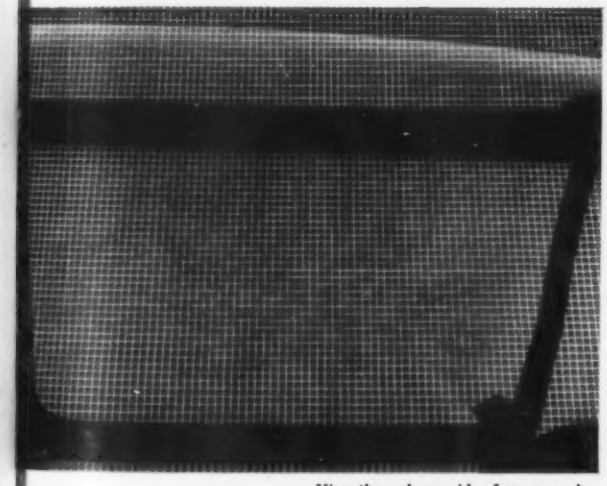
Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Magnetic servo amplifier	Dynamic Research Associates, div. Univ. Match Corp.	MA-408	1.6" x 1.6" x 2.1"	6 oz.	400 cps, 115v full	To drive size 10 servo motor
Motor-AC torque	Gray & Huleguard, Inc.	123-001	1.4" x 3.9" dia.	1.8	115v-400c 2 phase 25w 25 in. lb. (min.) @ 115v	
Motor-aircraft	Jack & Heintz	22184-000	5" x 4" dia.	7	1 hp	400 cps ac motor for aircraft, missile and ground use
Motor-DC	Gray & Huleguard, Inc.	129-560	6.2" x 3.6"	5.2	27vdc-7300 rpm F.L. 10.5a-.25 hp	Continuous duty high temp. motor
Motor, stepper	Land Air, Inc.		lgth.-2.5" dia.-1.5"	0.5	28 vdc, 15 steps/sec. 36° per step for SM-300-1	Bidirectional, missiles, automatic systems
Overspeed trip	Gray & Huleguard, Inc.	501	3.7" x 2.8" dia.	2.0	Trip speed 44 000 rpm ±1% optional speeds 90-95-105% of rated	For rocket engines.
Potentiometer-high precision	Waters Mfg. Inc.	WP	½" to 1⅝" dia.	¼ oz. to 1½ oz.		
Potentiometer-miniature precision	Waters Mfg. Inc.	AP½	⅜" to ½" dia.	¼ oz.	50 ohms to 20k resistance	
Potentiometer-miniature precision	Waters Mfg. Inc.	HTI	⅜" x 1"	¾ oz.	Up to 300° C. for 1 watt.	Experimental but for sale and has been sold for evaluation
Potentiometers, precision wire wound	Spectrol Electronics Div. of Carrier Corp.	110	1⅛" dia.		Single-turn	For missile, navigation and servo systems.
" "	" "	120	1 1/16" dia.		Single-turn	" " " " "
" "	" "	130	1 5/16" dia.		Single-turn	" " " " "
" "	" "	820	1 7/16" dia.		3-turn	" " " " "
" "	" "	870	1 7/16" dia.		10-turn	" " " " "
" "	" "	550	⅞" dia.		3-turn	" " " " "
" "	" "	170	1 7/16" dia.		Single-turn	" " " " "
" "	" "	190	1⅛" dia.		Single-turn	" " " " "
" "	" "	810	1 13/16" dia.		10-turn	" " " " "
" "	" "	830	1 13/16" dia.		3-turn	" " " " "
Power supply, engine driven	American Machine & Foundry Co., Turbo Division	63	12⅝" x 7¼"	37.5	150-300 watts, 28 volts dc or-115-170vac, 1 or 3 phase	Generator for air-to-air missile, operates on liquid fuel
Relay miniature	Iron Fireman Mfg. Co., Electronics Div.	R509 RS500		80 grs.	Micro- and multi-second times	Aircraft Radar; navigation equipment in missiles.
Servo unit-rotary rudder	Gray & Huleguard, Inc.	476-2	9.4" x 2.4" x 6.1"	8.0	Torsional resis. 600-in.-lb. @ 2 rad/sec. op. pres.-3000 psi 1800 in.-lb. load	Servo rudder FJ-4
Shunts-military	Janco Corp.	MSA, MSB MSC		1	30 to 1200 amps 50 mv rating	Current reading meters
Switch, actuator	James Cunningham Son & Co., Inc.	L22B	1" x 1" x 2"	50 gr.	Up to 600 gr. pull	Test equipment.
Switch, coaxial	CADO Mfg. Div. of Electromation	2-SN-27	2¾" x 2⅛" x ⅞"	4.5 oz.	2 million cycles @ 26 vdc to Mil-E-5272A	Radio frequency switch (SPZT) (antenna seeking, etc.)
" "	" " " "	2-SHN-27	2¾" x 2⅛" x ⅞"	4.5 oz.	" " " "	" " " " "
" "	" " " "	3-B-26 4-B-26	1.65" x 1.375" x 1"	7 oz.	1 million cycles min. @ 26vdc (range 18/30)	Multiple RF output operation (SP34T)
" "	" " " "	3-N-26 4-N-26	" "	7.5 oz.	VSWR 1.d max. to 3,500 mc	" " " "
Switch, crossbar	James Cunningham Son & Co.	F	11" x 8" x 5"	12	600 input	Missile, aircraft circuit analyzers.
Switch, crossbar scanner	" " "	SC1A	14" x 14" x 14"	80	Up to 2,500 inputs	Automatic test equipment.
Switch, float	Aircraft Controls Co.	GHF5400	1½" dia. x 5"	8 oz.	SPDT 5 amp.	For aircraft fuel systems.
Switch, float	" " "	GF5500	1½" dia. x 2½"	6 oz.	SPDT 2½ amp.	Miniature.
Switch, lobing	CADO Mfg. Div. of Electromation	L-20	3¾" x 2" x 5¾"	29 oz.	40 db crosstalk, Mil-E-5272-A	
Switch, mercury pulse	Tensitron, Inc.		3" x 2" x 2½"	2 oz.	½ amp. at 24v	For flashing lights on airports.
Switches, rotary	Janco Corp.	1246			6 amp res. @ 28vdc 3 amp ind. @ 28 vdc	Cockpit panel controls.
Tach generator ac	Lyndon Aircraft Inc.	1201	4" x 2.312" dia.		45v output/1000 rpm. max. speed 7,400 rpm.	For missile launcher
Thermocouple assy. ¼-⅛ immer.	Gray & Huleguard, Inc.	458-459 460	5" x .250" dia. 7.00" x 148 dia.	.13 to .19	Max. temp. 550° cont. Ranges: —352°F to 290°F; +200° to +500°F	For rocket engines
Transducer-rotary	Crescent Engineering & Research Co.	RT-22	1¼" dia. 1" length	2.75 oz.	—70° to 180°F. 1% linearity over 120° rotation	Frequently used in pairs for null-balancing servo control of aircraft and missile control surfaces.
Voltage regulator & switchgear	Cline Electric Mfg. Co., Aircraft Products Division	CL-9200 -C-4	48½" x 30" x 10¼"	450	208v, 3-phase, 400 cps, 60 kva	Ground power supply for Snark missile
Voltage regulator-aircraft line	Dynamic Research Associates div. of Univ. Match Corp.	VR-401-1500	8" x 6" x 10.5"	20	115v, 400 cps	No failure causes voltage to exceed 125v.



Republic F-105 canopy in front of standard test acceptance grid. Any defect in optics would result in distortion of the grid lines. Note that the Swedlow stretched acrylic Republic F-105 canopy, in a compound contour shape is virtually distortion-free.

Above: View through two sides of canopy.

NOW! SWEDLOW "STRETCHED ACRYLICS" PROVIDE GOOD OPTICS ON REPUBLIC F-105



View through one side of canopy only.

Now... on a "production basis"... aircraft canopies and windshields in compound contours are being fabricated of Swedlow stretched acrylic materials... with good optics.

SWEDLOW "STRETCHED ACRYLICS" HAVE AMAZING PROPERTIES

Stretching of acrylics has been a Swedlow-sponsored development over the last few years. The process involves the *molecular rearrangement* of acrylic sheeting by *appreciable* mechanical stretching.

Results:

Excellent Optics and Visibility	*Higher Resistance to Stress Crazing*
Greatly Improved Toughness	*Reduced Notch Sensitivity*

Swedlow offers highest quality workmanship and service, reliable delivery performance, technical expertness in formulating and fabricating plastics.

For full information, write today!

Republic's F-105 Thunderchief, newest supersonic fighter-bomber developed to deliver nuclear weapons and heavier loads of conventional bombs and rockets at extremely high speeds over long ranges, feature Swedlow-produced stretched acrylic canopies and windshields.

The F-105 encompasses such outstanding design features as the long, cylindrical fuselage, the short, very thin swept-back wings, the needle nose, and the ventral fin on the bottom of the aft fuselage near the tail. Design based on Area Rule. Wing span, over 30 ft. Length, over 60 ft. Powered by Pratt & Whitney J-75, 15,000 lb-thrust class, turbo-jet engine plus afterburner. Speed—supersonic.

Careful, technically accurate efforts go into the fabrication of each Swedlow stretched acrylic part. Republic F-105 canopy being fabricated in Swedlow plant.

Windshield on Republic's F-105, as on many other fighters and bombers, is also of Swedlow stretched acrylic... produced on a "production basis"... with good optics and contour.

Los Angeles, California

Youngstown, Ohio

Please refer to Dept. 11

Swedlow
PLASTICS COMPANY

FROM AN ORIGINAL PAINTING FOR CECO BY R. T. HANDVILLE

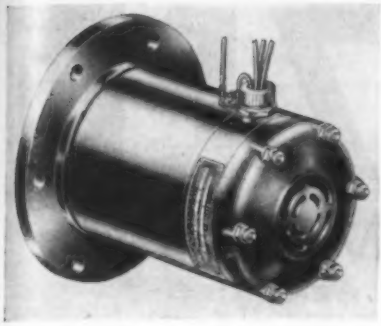
Contributing to superb performance . . . Grumman's F11F-1 Tiger is powered by a Wright J-65 turbojet with *main fuel pump* engineered and built by Chandler-Evans.

Products, too, are "known by the company they keep", and CECO is proud to be airborne with many of the latest and finest military and commercial aircraft.

CHANDLER-EVANS • WEST HARTFORD 1, CONNECTICUT

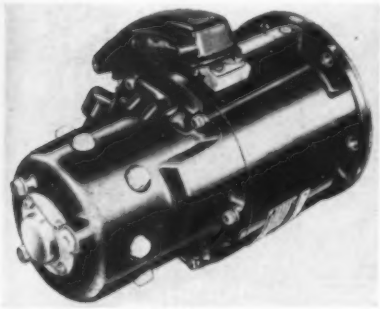
Write to Dept. 5M for an informative folder on CECO's new SMALL ENGINE FUEL CONTROLS, *or for folders on:* AFTERBURNER FUEL CONTROLS; AIRCRAFT PUMPS; UNITIZED FUEL CONTROL SYSTEMS.

CECO
SYSTEMS / CONTROLS



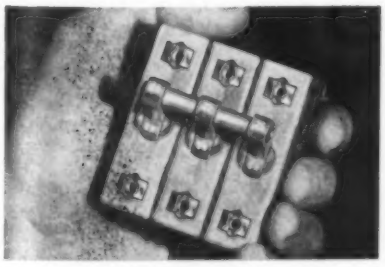
AC AIRCRAFT MOTOR

Mfr.: Jack & Heintz
Model: 22188-000
Size: 5.33″ x 4.69″ dia.
Weight: 9.8 lbs.
Rating: 2 hp.
Remarks: 400 cps ac motor for aircraft, missile and ground applications.



OIL-COOLED AC GENERATOR

Mfr.: Jack & Heintz
Model: G280-1
Size: 15¼″ x 7.5″ dia.
Weight: 51 lbs.
Ratings: 17 kva continuous load at .75 pf.
Remarks: Used with constant speed drive on interceptor aircraft.



CIRCUIT BREAKER

Mfr.: Heinemann Electric Co.
Model: AM17
Rating: Interchangeable for 400 cps ac as well as dc use.
Remarks: Designed primarily for aircraft circuits and airborne equipment use. Manufactured in single-pole form only. However, they can be readily linked to make two or three-pole companion trip units. Meets MIL Specification requirements with regard to vibration, temperature acceleration and environmental factors.

Other product sources

Aircraft wire/cable—Wm. Brand & Co. (low-tension wire) per Spec. MIL-W-5086A, C-7078A, W-5274A, NAS-702.

Blower, cooling—Rotron Mfg. Co.; Aximax III blower for cooling electronic gear on missiles and aircraft; dimensions 2 5/16″ x 3″ x 3″, weight 13 oz. Rated for 160 cfm free delivery.

Breakers, circuits—Frank Adam Electric Co.; 10 to 50 amp; 1, 2 and 3-pole for lighting circuit protection.

Bus bar ducts—Frank Adam Electric Co.; 100 amp; with 30-amp fused plug-in device to supply power to assembly lines for tools.

Connectors—Cannon Electric Co.; new DPE, DPG and DPJ miniature connectors.

Circuits, etched and plated—Labko Scientific, Inc.

Coaxial cables—Wm. Brand & Co. per Spec. MIL-C-17B, JAN-C-17A.

Coaxial cables—Tensolite Specialties, Inc.; air-dielectric, Teflon-insulated, miniature cable. Capacitance 9 mmf/ft.; nominal dia. is .220″.

Computer components—Belock Instrument Corp.; squaring mechanism, matching dial, component solver and miniature differentials.

Connectors, hi-voltage—Joclin Mfg. Co.; hermetic seal up to 45 psi; −65 to 200°C.

Connectors, miniature—Scintilla Div., Bendix Aviation Corp.; pygmy miniature AN type; also short "E" electrical connectors.

Electromagnetic controls — Automatic Switch Co.; transfer Switches, relays, control panels, etc. for airport and plant lighting; emergency power systems and electronic control systems.

Fan, variable frequency—Rotron Mfg. Co.; 75 to 115 cfm free-delivery fan for flushing cool air through check-out equipment cabinet. Measures 3½″ x 5 23/32″ x 5 23/32″; weight is approx. 2 lbs.

Hook-up wires—Wm. Brand & Co. per Spec. MIL-W-76A, W-16878B.

Magnet wire (Teflon) R & D kit—Tensolite Specialties, Inc., kit contains 12 spools of Teflon-coated magnet wire, sizes 20 through 42 AWG.

Miniature differentials—Belock Instrument Corp.

Patch cords, double plug, stack up—Pomona Electronics Co., Pomona, Calif. Model 2BA for instrumentation patching.

Protected wiring assemblies — Scintilla Div., Bendix Aviation Corp.

Switches—Electro-Snap Switch & Mfg. Co.; hermetically sealed, rotary (Model H10-7) 4-circuit SPST or DPDT; with circuit adjustable externally.

Switches, actuator—Electro-Snap Switch & Mfg. Co., changeable circuit act. switch; SPST or TPDT; accepts 3 basic switches for wide range of circuits.

Directory of manufacturers

For additional information on products listed in this section, write to manufacturers at address below, attention Sales Manager. Give page number and refer to AMERICAN AVIATION ENGINEERS HANDBOOK of new products.

Aircraft Controls Co., Div. Gorn Electric Co., Inc., 845 Main St., Stamford, Conn.

American Machine & Foundry Co., Turbo Div., 10445 Glenoaks Blvd., Pacoima, Calif.

Automatic Switch Co., Florham Park, N. J.

Autotronics, Inc., Rt. 1, Box 812, Florissant, Mo.

Belock Instrument Corp., 111-01 14th Ave., College Point, N. Y.

Wm. Brand & Co., Inc., The, North & Valley Sts., Willimantic, Conn.

Cado Mfg., Div. of Electromation Co., 1646 18th St., Santa Monica, Calif.

Cannon Electric Co., 3208 Humboldt St., Los Angeles, Calif.

Cline Electric Mfg. Co., Aircraft Products Div., 3405 W. 47th St., Chicago 32, Ill.

Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Frank R. Cook Co., 36 So. Santa Fe Drive, Denver 23, Colo.

Crescent Engineering & Research Co., 5440 No. Peck Rd., El Monte, Calif.

Dynamic Research Associates, Div. of Universal Match Corp., P. O. Box 5841, Ferguson, Mo.

Electro-Snap Switch & Mfg. Co., 4218-30 W. Lake St., Chicago 24, Ill.

Gray & Huleguard, Inc., 930 No. Hancock Ave., Los Angeles 46, Calif.

Heinemann Electric Co., Pennsylvania Ave. & Plum St., Trenton 2, N. J.

Janco Corp., 3110 Winona Ave., Burbank, Calif.

Joclin Mfg. Co., Lufburg Ave., Wallingford, Conn.

Land-Air, Inc., 7444 Wilson Ave., Chicago 31, Ill.

Lyndon Aircraft, Inc., sub. of Scovill Mfg. Co., 140 Clifford St., Newark 5, N. J.

Rotron Mfg. Co., Schoonmaker Lane, Woodstock, N. Y.

Scintilla Div., Bendix Aviation Corp., Sidney, N. Y.

Spectral Electronics Div., Carrier Corp., 1704 S. Del Mar Ave., San Gabriel, Calif.

Tensolite Insulated Wire Co., 198 Main St., Tarrytown, N. Y.

Waters Mfg. Co., Boston Post Rd., Wayland, Mass.

MODULIZED

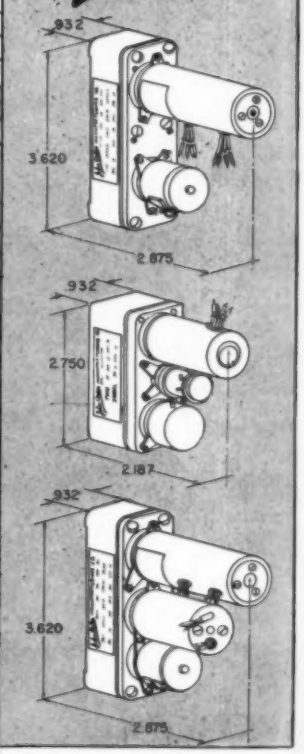
SERVO SYSTEMS

QUICKLY INTERCHANGEABLE . . . EASILY SERVICED

- Miniaturized
- Lightweight
- Simple, fast installation
- Meets MIL-E-5272
- Can be hermetically sealed with dimensional changes

OSTER TYPE	SB-9805-01	SB-9805-02	SB-9805-03	SB-9805-11
Motor				
Fixed Phase Voltage	26v	115v	115v	26v
Control Phase Voltage	26v	115v	115v	26v
Frequency	400	400	400	400
Max. Power @ Stall	6	5	5	6
No Load Speed	10,500	10,000	10,000	10,500
Generator				
Excitation Voltage Phase 1	26v			26v
Output Phase 2	0.3v/1000 RPM 100,000 ohm load			0.3v/1000 RPM 100,000 ohm load
Null	.012v			.012v
Wobble Voltage	.007v			.007v
(Power Excitation)	3.5 watts Max.			3.5 watts Max.
Linearity	0.5% to 4000 RPM			0.5% to 4000 RPM
Potentiometer				
Mechanical Rotation	360°	360°	360°	360°
Resistance	1000 ohms	50,000 ohms	50,000 ohms	1000 ohms
Accuracy of Total Resistance	±5%	±5%	±5%	±5%
Electrical Angle	350°	350°	350°	350°
Servo Block Unit				
Ambient Temperature	−55°C to 72°C	−55°C to 72°C	−55°C to 72°C	−55°C to 72°C
Altitude	−1000 feet to 55,000 feet	−1000 feet to 55,000 feet	−1000 feet to 55,000 feet	−1000 feet to 55,000 feet
Life	3000 hours excluding pot.	3000 hours excluding pot.	3000 hours excluding pot.	3000 hours excluding pot.
Gear Train				
Ratio	1000 : 1	336 : 1	167 : 1	10,000 : 1
Dust Enclosed per	Section 4.11 MIL-E-5272A	Section 4.11 MIL-E-5272A	Section 4.11 MIL-E-5272A	Section 4.11 MIL-E-5272A
Backlash	Anti-Backlash gear on pot.	1°	1°	Anti-Backlash gear on pot.
Synchro				
Input Voltage—Stator	11.8v			
Output Voltage—Rotor	10.6v			
Clutch Brake				
Input Voltage		100v dc	100v dc	
Input Power		2.0 watts Max.	2.0 watts Max.	
Operate Time—Energize		5 milliseconds	5 milliseconds	
Operate Time—De-energize		20 milliseconds	20 milliseconds	

Oster®



Offered as illustrated with identical or different combinations of:

gear ratios	servo
clutch	synchro
brake	motor-tach
clutch-brake	potentiometer

Write for further information TODAY, enclosing details of your requirement.

Other products include motor-gear-trains, synchros, AC drive motors, DC motors, servo mechanism assemblies, motor tachs, servo torque units, reference and tachometer generators, actuators, motor driven blower and fan assemblies and fast response resolvers.

John Oster **MANUFACTURING COMPANY**
Your Rotating Equipment Specialist
Avionic Division
Racine, Wisconsin

Engineers For Advanced Projects:
Interesting, varied work on designing transistor circuits and servo mechanisms. Contact Mr. Zelazo, Director of Research, in confidence.

Circle No. 127 on Reader Service Card.

BARON BROWNE ADVERTISING

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Cargo release hook	Eastern Rotorcraft Corp.	S-45	7" x 9"	6.8	2,000 lb. capacity	In production for H-19 helicopter.
Cargo release hook	" " "	A-60	7" x 9"	7.6	4,500 lb. capacity	In production for H-34 helicopter.
Escape reel	Stanley Aviation Corp.		5½" x 5" x ¾"	3	Limits velocity of descent from heights (up to 20 ft.) to 7 fps.	For use by individuals to avoid injury in escape situations; e.g. from tail of transport after nosewheel collapse.
Helmet, protective	Mine Safety Appliance Co.	APH-5				Made of expanded polystyrene. This is a solid synthetic thermoplastic which has high energy absorbing characteristics.
Hostess chime	Electric Service Works, Delta-Star Electric Div., Porter Co. (Delaware)	96389	6½" x 3" x 2½"	13.4	22-28 vac 400 cycle cont. duty	Also available in dc.
Passenger seat	Burns Aero Seat Co.	B1806	40.25" x 46.5"	22	Infinite type recline lock, 15° to 39°	Deluxe seat for Fairchild F-27.
Passenger seat	TECO, Inc.	TE-570		9.5		Designed for high density seating.
Passenger seat	Flight Equip. & Engineering Corp.	501		34.5	9g forward facing	Series 500 Luxair seat for F-27, DC-3, etc.
Passenger seat-rotorcraft	" " " "	701		26	4.5g forward facing	Rotorcraft; fold-to-wall utility.
Reel, shoulder harness takeup	American Seating Co.	20 MA-2	4.75" x 4.73" x 1.25"	1.96	4000 lbs. ultimate. Built to MIL-R-8236.	Inertia locking.
Reel, shoulder harness takeup	" " "	21 MA-1	4.75" x 4.73" x 1.25"	1.83 incl. manual control	4,000 lbs. ultimate. Built to MIL-R-8236, Type MA-1.	Unidirectional; inertia locking.

Other product sources

Cabin materials—Duracote Corp.; Dura-Trim H-24, V-28 and V-213 for headlining, hat rack covering and sidewalls; T-28 for seating; V-218 for flooring.

Ejection seats—Stanley Aviation Corp.; upward and downward ejection seats for aircraft such as RB-66, F-104, F-106, P6M and F4H.

Ejection seats—Weber Aircraft Corp.

Emergency smoke signal—Van Karner Chemical Arms Corp., Div. of Van Karner Enterprises, Inc.; VK aircraft emergency signal.

Flares, rocket & parachute—Van Karner Chemical Arms Div., Van Karner Enterprises, Inc.

Flight number signs—Delta-Star Electric Div., Porter Co. (Delaware), Electric Service Works; for passenger loading ramps.

Galley inserts—Weber Aircraft Corp.; fiberglass-reinforced plastic inserts.

Kits, rescue & ration—Van Karner Chemical Arms Div., Van Karner Enterprises, Inc.

Passenger seats—Burns Aero Seat Co.

Passenger seats—TECO (Transport Equipment Co.), Inc.

Passenger seats—Weber Aircraft Corp.

Relief container—Air Associates Div., Electronic Communications, Inc.

Sea marker dye—Van Karner Chemical Arms Div., Van Karner Enterprises, Inc.

Very pistols—Van Karner Chemical Arms Div., Van Karner Enterprises, Inc.; 37 mm and 25 mm.

Directory of manufacturers

For additional information on products listed in this section, write to manufacturers at address below, attention Sales Manager. Give page number and refer to AMERICAN AVIATION ENGINEERS HANDBOOK of new products.

American Seating Co., Grand Rapids, Mich.

Burns Aero Seat Co., 3900 Cohasset St., P. O. Box 127, Burbank, Calif.

Duracote Corp., 350 N. Diamond St., Ravenna, Ohio.

Eastern Rotorcraft Corp., Rt. 313, P. O. 110, Doylestown, Pa.

Electronic Communications, Inc., Air Associates Div., Teterboro, N. J.

Flight Equipment & Engineering Corp., P. O. Box 38, Miami 48, Fla.

Mine Safety Appliance Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

Porter Co. (Delaware), Delta-Star Electric Div., 17th & Cambria Sts., Philadelphia 32, Pa.

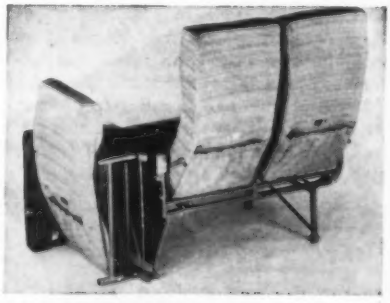
Stanley Aviation Corp., 501 Dallas St., Denver 8, Colo.

TECO, Inc. (Transport Equipment Co.), 3218 Winona St., Burbank, Calif.

Van Karner Chemical Arms Corp., Div. of Van Karner Enterprises, Inc., P. O. Box 426, Port Jervis, N. Y.

Weber Aircraft Corp., 2820 Ontario St., Burbank, Calif.

PASSENGER SEAT
Mfr.: Flight Equipment & Engineering Corp.
Model: 501
Weight: 34.5 lbs.
Rating: 9g forward facing
Remarks: For F-27, DC-3.



PAYLOADER SEAT
Mfr.: Flight Equipment & Engineering Corp.
Model: 100 Payloader
Weight: 21 lbs. per place
Rating: TSO C-25; forward-facing
Remarks: Track-mounted folding "pax" seat for DC-6.

UTILITY PASSENGER SEAT
Mfr.: TECO, Inc.
Model: TE-570
Weight: 9.5 lbs.
Remarks: for high-density seating; disposable seat sling can be replaced when stained or torn.

The catalog sheets shown here are descriptive of HOBART power supplies available to aviation and avionics industries!

Only at HOBART... can you get such a wide range of units to meet any type of ground power requirement.

Hobart machines are available to match the new requirements of today's aircraft, whether 400 cycle a.c., 28 or 112 volt d.c. In addition to the airlines and corporate users, airframe, powerplant, component part, helicopter and guided-missile manufacturers look to Hobart to meet their power supply needs.

It will pay to look into this! You can get your operations under way sooner and keep costs down when you use Hobart power supplies. 50 to 1500 amperes are available with wide continuously adjustable 26 to 31 volt range for either reciprocating or jet engine starting and testing. For the new jet aircraft and missile check-out and launching there are in the Hobart line, 400 cycle generators in capacities ranging from 3.75 to 125 KVA. This equipment is available in electric motor or engine driven designs and in the type of mounting you need. In other words, no matter what kind of equipment you're looking for, you can get it at one source—Hobart!

The company planning ahead in the fast-moving aviation field will do well to check into Hobart Power Supplies. Your inquiry will promptly bring complete literature and information on the equipment of interest to you. WRITE, PHONE, or WIRE today!

MOTOR GENERATOR CORPORATION — Hobart — TROY, OHIO — AUXILIARY POWER UNITS

MOTOR GENERATOR CORPORATION

Hobart Brothers Affiliate

Box AA-107, Troy, Ohio

Circle No. 123 on Reader Service Card.

Link jet trainer may cut flight-maintenance costs 60%

Will simulate performance of P&W JT-3, JT-4 engines for Boeing 707s and Douglas DC-8s

LINK AVIATION, INC. of Binghamton, N. Y., has unveiled a new electronic jet engine trainer company officials estimate will reduce airline costs about 60% in training flight and maintenance crews for the jet age.

The Link unit is designed to simulate performance of the Pratt & Whitney JT-3 and JT-4 (military J57 and J75) engines to be used by most airlines in Boeing 707 and Douglas DC-8 jets.

Major components of the trainer are: (1) an operable model of the jet engine scaled to a length of about six feet; (2) a pilot's engine instrument panel and control pedestal; (3) a system engineer's station having the same instruments and appearance as the aircraft installation; and, (4) an instructor's station with controls needed to simulate failures and emergency conditions as well as normal variable operating conditions.

Based on new jet engine costs of $235,000 each and overhaul cost of $33,000, Link engineers expect the trainer would save $91,205 in the indoctrination of 85 ground mechanics, 18 base mechanics and 102 flight personnel.

This would be realized by utilizing the trainer to take over about half of the task that normally would be accomplished using the actual jet aircraft with "live" engines for the training. At the same time, use of engines on run-in stands for training would be eliminated.

Instead of scheduling one hour per trainee on the jet engine on a run-in stand (at $165 per hr.) and another on the jet aircraft (at $660 per hr.), Link officials propose that one hour on the trainer and 30 min. on the aircraft would suffice.

For transition training of the 103 maintenance and 102 flight personnel, the company estimates the trainer/aircraft approach would cost $51,128. Using ground operation of live engines and a full hour of aircraft training, this figure jumps to $127,050—a difference of $75,000.

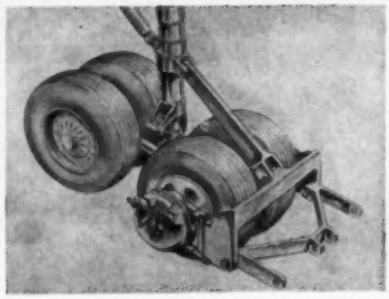
For progressive training of 21 maintenance technicians and 20 flight officers or instructors, the jet trainer costs only $25,575 compared to $91,-20[illegible] using actual engines and aircraft, according to Link. This represents an additional $65,630 saving.

Combining these figures, total cost of trainer-less training adds up to $152,625, whereas the same program using the Link trainer costs $61,420—a difference of $91,205.

Furthermore, company officials note, this does not take into account loss of revenue from assignment of engines and aircraft to training, possible accidents or student time and travel costs. By enabling training in class groups, Link feels the trainer approach would affect additional economies over the aircraft/engine method.

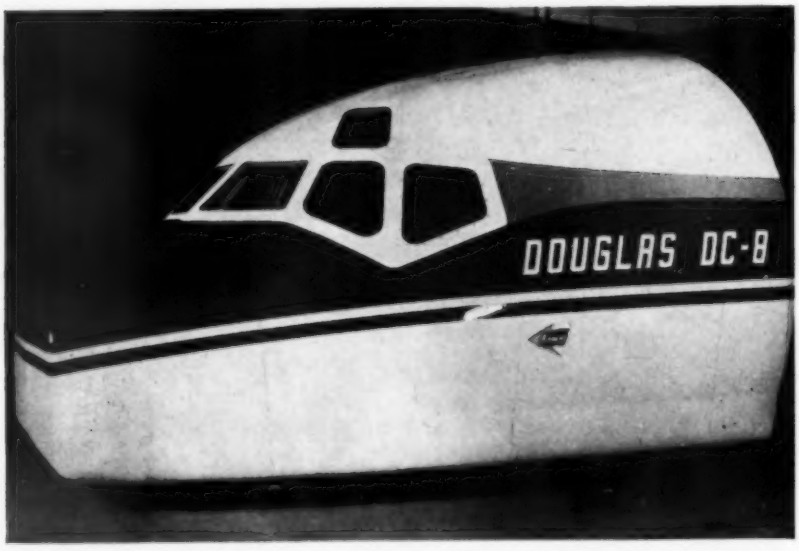
Although no specific price has been announced for the engine trainer, Link officials point out that the cost of a ruined engine would buy more than two trainers. With Link's own engine priced at $235,000, this means the trainer is being offered at some figure below $117,500.

AIR CONDITIONER, 3-TON
Mfr.: Pre-Flite Industries Corp.
Model: PF-10-3GP
Size: 56" x 45" x 38"
Ratings: 36,000 btu-400 cfm of 45° air.
Remarks: For aircraft ground use.



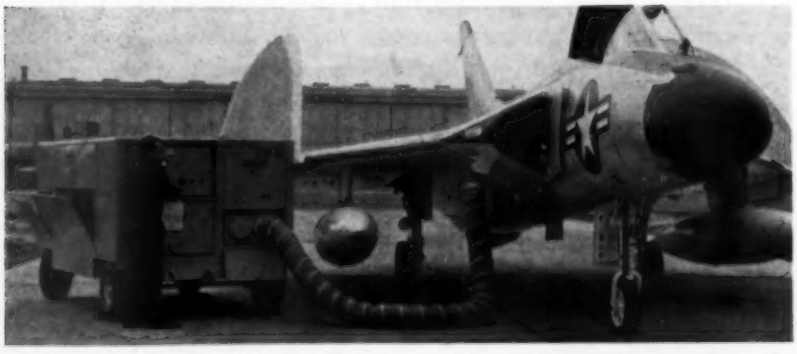
WHEEL MOVER UNIT
Mfr.: Consolidated Diesel Electric Corp.
Model: 250
Ratings: for 707, DC-8, 880, 188.
Remarks: To move and handle large jet aircraft or airport ramps.

Link molds plastic cockpit for DC-8 simulator



NEW APPROACH to fabrication of cockpit of large aircraft simulators employed by Link Aviation, Inc. produced this DC-8 section molded of glass fiber. Past practice was to order actual cockpit section from manufacturer which, in the case of jets, presumably would have delayed simulator delivery beyond date of initital aircraft operation. Link officials say plastic unit is cheaper to build in quantity, takes one-third the time of metal counterparts.

Air conditioner cools electronic equipment



ELECTRONIC EQUIPMENT on aircraft is cooled during pre-flight operations by the MA-7 ground support air conditioner manufactured by the Electrical Machinery and Equipment Division of American Electronics, Inc. Seven-ton unit is powered by an air-cooled engine, has dc motor for mobility.

Other product sources

Aircraft brake tester—Bennett-Feragen; Dynamometer type, reveals necessary adjustments.

Airport lighting (selector panel for high intensity lighting)—Kilgen Aircraft Div., The Kilgen Organ Co.; master selector control tower panel.

Altitude chamber—Vacuum Process Div., John Mohr & Sons; large custom chambers built to customer specifications.

Boxes—Albert Wesling & Sons, Inc.; Model M1324 measures 24" x 13½" x 3", weighs 8 lbs.; for handling precision equipment.

Containers, metal—The Champion Co.; custom-built for shipping and storing missiles, powerplants, guidance systems. Hermetically sealed.

Crash trucks—Ward LaFrance Truck Corp.; Model CW-750 fire and crash truck, Model MB-5 Navy crash truck.

Ground support equipment—Loewy-Hydropress Div., Baldwin-Lima-Hamilton; for rockets, missiles, engines.

Hydraulic systems—Ardmore Products; built to specifications up to 500 gpm, installed in trucks or trailers for delivery of aviation fuel, provided pumping system to move fuel from truck to plane and to drive hose reels.

Missile-handling equipment (launching towers, erector towers, umbilical towers, service towers, flame deflectors, engine test stands, LOX units, fuel tanks)—Kaiser Steel Fabricating Div., Kaiser Steel Corp; for Titan missile and aircraft.

Service vehicle—Fred S. Gichner Iron Works, Inc.; Truck has self-contained tanks for washing and de-icing aircraft including water, detergents, glycol or other de-icing fluids. Has 360° rotating crane with 64-ft. extension.

Silencers, jet engine—The Maxim Silencer Co., Div. of Emhart Mfg. Co.; complete packaged engineered silencing for jets.

Tow tractor—Ward LaFrance Truck Corp.; Model MB-2 Air Force heavy duty tractor.

Directory of manufacturers

For additional information on products listed in this section, write to manufacturers at address below, attention Sales Manager. Give page number and refer to AMERICAN AVIATION ENGINEERS HANDBOOK of new products.

Accessory Controls & Equipment Corp., 146 Willard Ave., Newington, Conn.

Air-Dry Corp. of America, 14756 Keswick, Van Nuys, Calif.

Air Logistics Corp., 3600 E. Foothill Blvd., Pasadena, Calif.

American Electronics, Inc., Electrical Machinery & Equipment Div., 655 W. Washington Blvd., Los Angeles 15, Calif.

The American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa.

Albert & J. M. Anderson Mfg. Co., 289 A St., Boston 10, Mass.

Ardmore Products, Northbrook, Ill.

The Champion Co., Springfield 99, Ohio.

Consolidated Diesel Electric Corp., Ludlow & Canal Sts., P. O. Box 1456, Stamford, Conn.

Emhart Manufacturing Co., Skyworker Div., 83 Ford St., Milford, Conn.

Bennett Feragen, 1408 Jerome, Niles, Mich.

Flexonics Corp., 1352 S. Third Ave., Maywood, Ill.

Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

General Sound Control, Inc., Div. of Hancock

(Continued on Page 86)

One-man fire, crash, rescue truck

FRED S. GICHNER Iron Works, Inc. offers this one-man rescue truck. Model MB-2 measures 16'8" x 6'3" x 9'10", weighs 7,330 loaded. Capacity is 200 gals. water, 25 gals. foam, pump delivers 1,200 gpm. Maximum speed of vehicle is 50 mph.

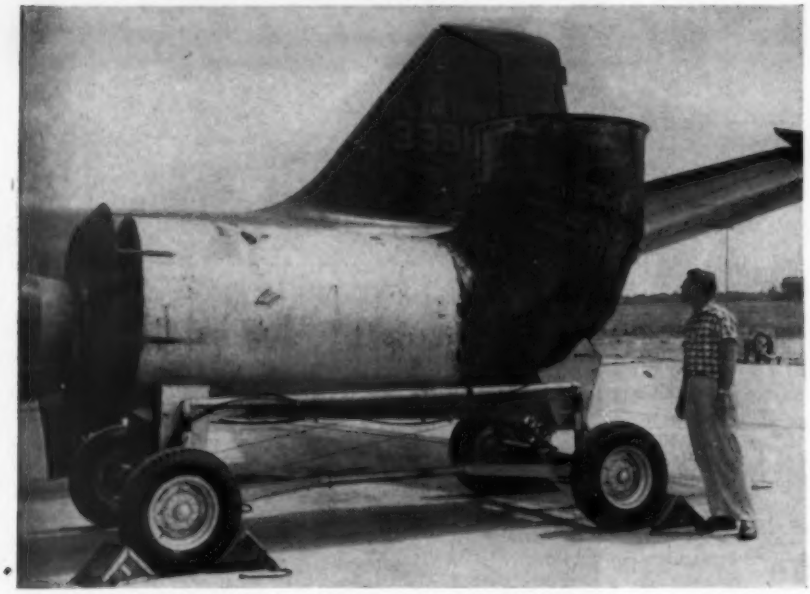
Airport sweeper keeps ramps clean

A PATH 10 ft. wide is cleaned by Wayne Manufacturing Co. sweeper model 2-450. Unit measures 9'1" x 15'8" x 83", weighs 11,200 lbs. Hopper capacity is 3 cu. ft. Company has other models with one and two gutter brushes, larger and smaller hoppers. Above unit has no vacuum cleaner.

Liquid oxygen container

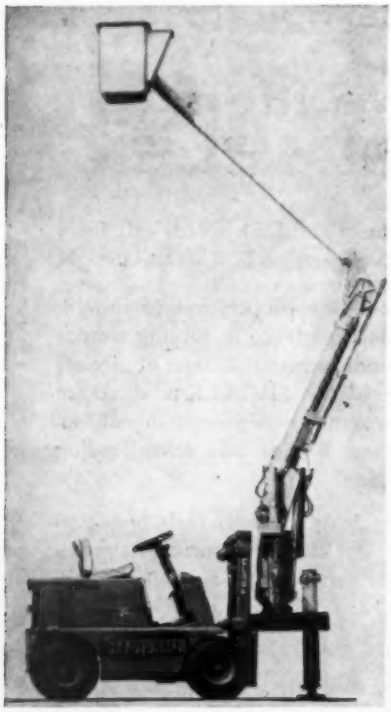
CONSTRUCTED to military specs by Ronan & Kunzl, Inc., Models 50-2 and 50-3 have capacities of 50 gal. liquid and 5,760 cu. ft. gaseous oxygen. Unit measures 106" x 68" x 54", weighs 1,500 lbs. Navy uses type NO-4 (50-3), Air Force MA-1 (50-2).

Martin builds jet noise muffler



LOW-COST PORTABLE jet engine muffler has been developed by The Martin Co. for use at military and civil airports. Depending on aircraft for which muffler is used, units vary in price from $500 to $10,000, opposed to $60,000-$100,000 for existing types. Reason for wide range of prices is widely different requirements of aircraft and test stand installations.

Two-man service stand



WIDE-RANGE of working heights is available with Emhart Manufacturing Co. Skyworker hydraulic lift for servicing such aircraft areas as vertical fins. Unit has dual crow's nest for operations requiring two men aloft. Maximum extension is 41 ft., rotation is 400°—40° past full circle.

(Directory continued from p. 84)

Industries, 6711 S. Sepulveda Blvd., Los Angeles 45, Calif.

Frank Adam Electric Co., 3650 Windsor, St. Louis, Mo.

Fred S. Gichner Iron Works, Inc., 1214 24th St., N.W., Washington 7, D. C.

Hi-Shear Rivet Tool Co., 2600 W. 247 St., Torrance, Calif.

Kim Hotstart Mfg. Co., W. 917 Broadway, Spokane 11, Wash.

The Frank G. Hough Co., Libertyville, Ill.

Hunter Manufacturing Co., 30525 Aurora Road, Solon, Ohio.

Industrial Acoustics Co., Inc. 341 Jackson Ave., New York 54, N. Y.

Iron Fireman Mfg. Co., Electronics Div., 2838 S.E. Ninth Ave., Portland, Ore.

James Cunningham, Son & Co., Auto Bldg., Rochester 8, N. Y.

Kaar Engineering Corp., Middlefield Road, Palo Alto, Calif.

Kahn & Co., Inc., 541 Windsor St., Hartford 1, Conn.

Kaiser Steel Corp., Kaiser Steel Fabricating Div., Fontana Works, P. O. Box 217, Fontana, Calif.

Kilgen Aircraft Div., The Kilgen Organ Co., St. Louis, Mo.

Link Aviation, Inc., Hillcrest, Binghamton, N. Y.

Lowey-Hydropress Div., Baldwin-Lima-Hamilton, 111 Fifth Ave., New York 3, N. Y.

Luria Engineering Co., Bethlehem, Pa.

The Martin Co., Baltimore 3, Md.

The Maxim Silencer Co., Hartford 1, Conn.

John Mohr & Sons, Vacuum Process Div., 3209 E. 96th St., Chicago 17, Ill.

Motor Generator Corp., W. Water St. at Jackson, Troy 2, Ohio

Geo. F. Nelson Vacuum Pump Co., 2133 Fourth St., Berkeley 10, Calif.

Packmasters, 1058 Home Ave., Akron 10, Ohio.

Parameters, Inc., 195 Herricks Road, Garden City Park, P. O. New Hyde Park, N. Y.

Pre-Flite Industries Corp., 16706 Garfield Ave., Paramount, Calif.

Ronan & Kunzl, Inc., Brooks Airport, Marshall, Mich.

Safeway Steel Products, Inc., W. State St. at 43rd St., Milwaukee 13, Wisc.

Tensitron, Inc., Pin Hill, Harvard, Mass.

I. Spiewak & Sons, 112 W. 34 St., New York, N. Y.

U.S. Propellers, Inc., 3270 E. Foothill Blvd., Pasadena 8, Calif.

Vickers Inc., Detroit, Mich.

Ward LaFrance Truck Corp., Elmira Heights, N. Y.

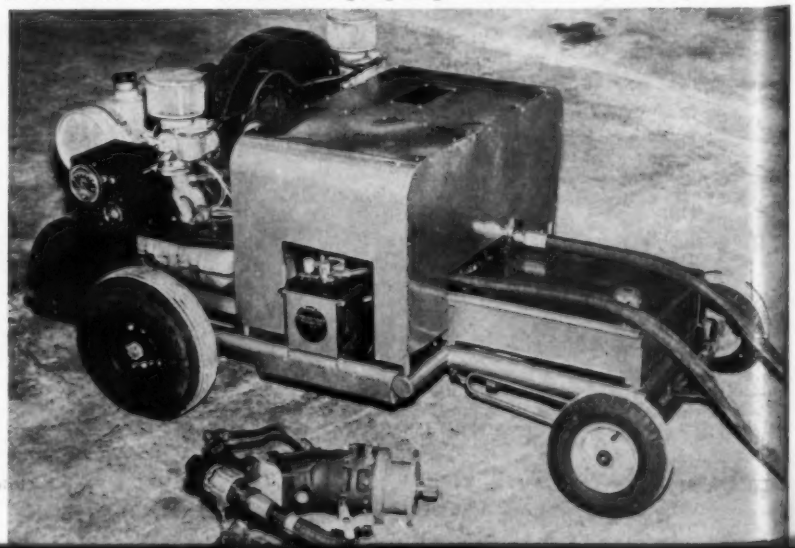
Wakefield Engineering Co., P. O. Box 471, Coeur d'Alene, Idaho.

Wayne Manufacturing Co., 1201 E. Lexington St., Pomona, Calif.

Albert Wesling & Sons, Inc., 2912 West Lake St., Chicago 12, Ill.

Hydraulic package starts jet engines

PORTABLE HYDRAULIC ground-mobile jet engine starter includes a Vickers EDV pump driven by a lightweight air-cooled gasoline engine. Engine on model shown is Porsche. Units exclusively for ground-support use may use Chevrolet Corvette engine. Another option is the McCulloch four-cylinder engine. In foreground is Vickers constant displacement piston motor that is mounted on engine pad to start the turbine. Starter motor can be used also as a pump to provide airborne hydraulic power.



Product data - ground support equipment

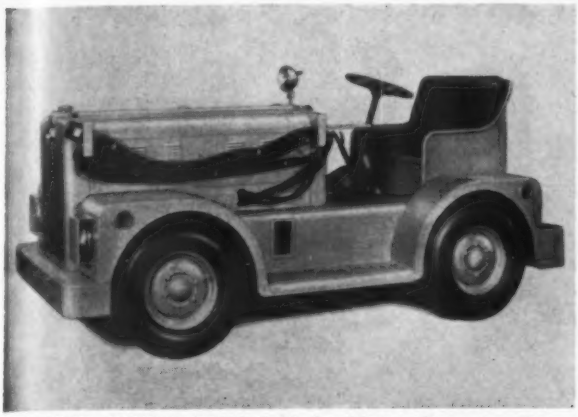
Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (Lbs.)	Ratings	Remarks
Air conditioner	American Electronics, Inc.	MA-7	120" x 72" x 68"	4,850	7 ton (84,000 btu cooling).	For cooling aircraft & missile electronics equip. during servicing & preflight.
Air conditioner	American Electronics, Inc.	MA-8	96" x 72" x 68"	4,600	7 ton unit.	" " " "
Air conditioner	American Electronics,	MA-3M	128" x 78" x 76"	7,750	11½ ton unit.	" " " "
Air conditioner	Pre-Flite Industries Corp.	PF-113 AC	100" x 72" x 68"	4,500	10 ton unit. 120,000 btu—100 cfm of 45° air at 4 psi with ambient of 100°F.	Aircraft ground use, electric or gas engine
Aircraft mover	Air Logistics Corp.	10,000	249" x 90" x 55"	14,000 to 24,000	500 hp.	Wheel base 155", ground clearance 8".
Connector plug-ground power	Albert & J. M. Anderson Mfg. Co.	R-64	6⅜" x 1½" x 3⅜"	1¼	With 1/0 cable 200 amps cont., 300 amps ½ hr., 600 amps 3 min.	AN2551 type cable assembly with No. 12 control wire.
" " "	" " "	R-65	6½" x 1½" x 3⅜"	1¼	With 4/0 cable 400 amps cont., 500 amps 1 hr., 1,000 amps 3 min.	AN2551 type cable assembly.
" " "	" " "	R-67	8½" x 2½" x 3¼"	2¾	With 1/0 cable 200 amps cont., 300 amps ½ hr., 600 amps 3 min.	AN3430 type cable assembly.
" " "	" " "	R-71	7½" x 1¾" x 3¾"	1½	With 4/0 cable 400 amps cont., 500 amps 1 hr., 1,000 amps 3 min.	MS25019 type cable assembly.
Container, liquid oxygen	Ronan & Kunzi, Inc.	LOX 50-2 LOX 50-3	75" x 36¼"	447 553		Tank holds vacuum below 50 microns. Evaporation rate 2.5 to 4.5% by volume each 24 hrs.
Container, liquid oxygen	Ronan & Kunzi, Inc.	LOX 150	100½" x 50" x 54½"	890		Holds 150 gal. liquid oxygen at 70°F, atmospheric pressure. Additional tank space for expansion is 10%.
Container, liquid oxygen	Ronan & Kunzi, Inc.	LOX 500-1	146½" x 65½" x 70½"	2,480		Holds 500 gal. same conditions as Model LOX 150.
Cryotainer	Ronan & Kunzi, Inc.	Series 1000	13' x 6½' x 7'2"	5,050 to 11,150 according to type		Available in four models. Three stationary & one transport.
Dehumidifier	Accessory Controls & Equipment Corp.	ACE-17-2	8" x 14" x 24"	150	Will dry air to dew point of —65°F at 1,000 psi and 90°F at 5,000 psi.	Operates on 110vac single phase 60-cycle or to customer's requirements.
Dehydrator, air	Air-Dry Corp. of America	SR-6000 200-110	30" x 18" x 60"	850	200 scfm @ 6,000 psig to —110°F dew point.	Removes oil-water particles for general testing applications.
Dehydrator, hydrogen	Air-Dry Corp. of America	SR-50-10-110	30" x 18" x 32"	250	500 scfm @ 50 psig to —110°F dew point.	Removes oil & water for atmospheric furnace applications.
Diesel Unit, lightweight	Consolidated Diesel Elec. Corp.	4031	65" x 20" x 46"	1,900	15kw, 120/208v, 240/416v, 60N.	For missile power; unit winterized for —65°F operation.
Engine-alternator, generator set	American Electronics, Inc.	415-C	107" x 50" x 56"	3,580	15kva output at .75 pf; 3 phase, 400 cps ± 20 cps.	For flight-line service and maintenance.
Exhaust silencer-jet	General Sound Control, Inc.	N-400		Approx. 70,000		Designed for use with F-100 Series and F-102 Series aircraft. Can also be used for engine testing.
Ground Power Unit	Motor Generator Corp., Hobart Bros. Affiliate	3075	96¼" x 30" x 46"	3,000	Two 30 kw dc generators.	For servicing DC-6B, Brittannia.
Ground Power Unit	" " "	489-HV	46¾" x 44⅝" x 21⅜"	1,485	22kw, 200 amp, 112 vdc	For servicing Brittannia.
Ground Power Unit	" " "	3044-S	105" x 64" x 64½"	2,760	200 amp, 112 vdc	For servicing Brittannia.
Ground Power Unit	" " "	3044	105" x 64" x 64½"	3,140	Two dc generators with combined rating of 28kv.	For servicing Brittannia.
Ground Power Unit	" " "	3076	152½" x 64" x 58"	5,050	Two dc generators with 30kw combined rating.	For servicing DC-6B or Brittannia.
Ground Power Unit	" " "	3036	181" x 77" x 72"	10,000	125kva or 100kw at .8 pf. 120-208v, 346 amp, 3 phase, 4-wire, 400 cycle ac.	For servicing 707 or 880.
Heater, engine	Hunter Manufacturing Co.	UH-86	10" x 26⅝" x 8"	38	85,000 btu/hr.	Missiles—ground support program.
Heater, preheater	K m Hotstart Mfg. Co.	JR-110, JR 220	8" x 4" x 4"	6	750w, 115/120v 750w, 230/240v	Engine pre-heater for ground power equipment.
" "	" " "	A 110, A 220	8" x 4" x 4"	6½	1,000w, 115/120v 1,000w, 230/240v	" " " "
" "	" " "	BC-110, BC 220	15" x 5" x 5"	9	2,500w, 115/120v 2,500w, 230/240v	" " " "
" "	" " "	E 220	15" x 5" x 5"	11	4,000w, 230/240v	" " " "
" "	" " "	WJ 110, WJ 200	8" x 4" x 4"	6	500w, 115/120v 500w, 230/240v	" " " "
" "	" " "	LB 110, LB 2200	15" x 5" x 5"	9	1,500w, 115/120v 1,500w, 230/240v	" " " "
" "	" " "	MB 110, MB 220	15" x 5" x 5"	9	2,000w, 115/120v 2,000w, 230/240v	" " " "
Heater, space multi-fuel type	Hunter Manufacturing Co.	UH-68	11" x 24" x 2"	135	60,000 btu/hr.	Missile ground support.
Hoist, engine	Safway Steel Prods., Inc.		16" x 16" x 22"	2,000	Operating 5,000 lbs. Proof 10,000 lbs.	Safely moving bulky aircraft components.
Hydraulic power units	Hi-Shear Rivet Tool Co.	100, 200	19½" x 11¾" x 14" 17" x 16½" x 23"	75 85	Demand system sustained pressures: 0-3000 psi	Air-hydraulic or electric hydraulic portable power for test or production applications.
Hydraulic pump cart	Accessory Controls & Equip. Corp.	ACE-49	30½" x 42" x 50"	2,000	Up to 5,000 psi.	Portable.
Hydraulic test carts	Pre-Flite Industries Corp.		40" x 20" x 42"	450	10-20-30 gpm at 3,000 psi variable vol. & pres.	Aircraft ground testing.

Sit-down, self-propelled power supply

Product data - ground support equipment *(Continued)*

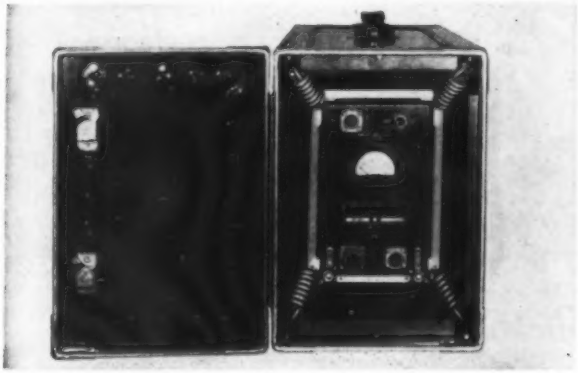
Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (Lbs.)	Ratings	Remarks
Hydrostarter	Pre-Flite Industries Corp.	HS-3	44" x 68" x 50"	8,000		New self-propelled tug unit providing ac-dc supply and starting any jet or turboprop engine hydraulically.
Jet engine dust cover	Air Logistics Corp.	2700	178.7" x 51.3" x 31.6"	56 to 80		For J35, J47, J57, J65, J79, J75.
Leakage detector sealed cavity	Accessory Controls & Equipment Corp.	ACE-12	24" x 24" x 28"	95		Uses photo-electric cell and circuit counter for detection.
Liquid oxygen transfer assembly	Flexonics Corp.		⅜" to 2" ID; 2.39" to 4.356" OD		Complies with AMC Dwg. 55C-6000.	Liquid oxygen transfer. When hose carries liquid oxygen @ —265°, outside surface will not drop below 40° in ambient of 70°.
Mobile gen. unit, high voltage	Consolidated Diesel Elec. Corp.	4026	140" x 94" x 77"	9,000	75kva, 400 cps, 1000v	Power to moored blimps.
Mobile high pressure air stand	Accessory Controls & Equipment Corp.	ACE-120	66" x 59" x 92"	3,600	5,000 psi, dryness—-65°F dewpoint.	Has 2 micron filters and compressor capable of supplying 15 scfm.
Mobile high pressure bottle trailer	" "	ACE-121	66" x 59" x 92"	4,200	16,000 cu. in.	Companion unit to AC-120.
Mobile jet engine run-up and test system	Air Logistics Corp.	12,000A	varies	varies	Any jet up to 35,000 lbs. thrust.	Has matching rail and roll transfer facilities.
Noise control—engine test cell	Industrial Acoustics Co.				J75 engine	Prototype airline jet test cell noise control.
Noise control—engine test cell	" "				Jet engines with thrusts up to 50,000 lbs.	Test cell noise suppression equipment designed for Orenda Engines, Ltd. to accommodate engines of the future.
Noise control—missile test cell	" "				Northrop's SM-62 (Snark)	Noise suppression equipment for preflight count-down test facility.
Noise control—overhaul test cell	" "				J75 engines	Designed for Pacific Airmotive Corp.
Noise suppressor—multijet	" "	MJ-47 MJ-65 MJ-75		225 245 300	J47 engine J65 engine J75 engine	Lightweight portable noise suppression equipment for silencing jet engine exhaust during ground tests.
Pneumatic ground starter	Pre-Flite Industries Corp.	HAS 317-SM	120" x 96" x 64"	16,000	Pneumatic starting for all jet & turboprop eng.	Developed specifically for Lockheed Electra.
Power supply, uninterrupted	Consolidated Diesel Elec. Corp.	UPS	varies for rating 60 kw-10' x 4' x 6'	8,000	15, 30, 60, 100 kw	Offers continuous source of power for missiles, radar, etc.
Power unit, mobile	Consolidated Diesel Elec. Corp.	60E	120" x 60" x 48"	5,500	For 707, DC-8, 880, 188	Electrical servicing unit for large jet aircraft.
Pressurizing stand	Kahn & Co., Inc.	KC-1037			Delivers 15 scfm of dry air at pressures to 5,000 psig	Fully enclosed, mounted on trailer.
Propeller tester, portable hydraulic	Accessory Controls & Equipment Corp.	ACE-84	30½" x 32" x 28½"	2,300		For reversible pitch propellers. Has integral heating and cooling facilities.
Purifier, helium	Air-Dry Corp. of America	AD-1600-HE	80" x 72" x 84"	3,600	5,000 scfh @ 6,000 psig	Removes oxygen, nitrogen, oil, water, etc. from helium.
Radiotelephone, mobile	Kaar Engineering Corp.	IMP	13½" x 9½" x 6½"	24	3w input (max. per FCC rules for low power industrial service)	For use on airport service and maintenance vehicles.
Rollover trailer	Air Logistics Corp.	5000	152" x 69" x 45" (at bed)	1,000	6,000 lb. capacity	MIL-M-8090.
Snow plow	Frink Sno-Plows	2409 MRT 2409 PRT	24" x 9'	1,370 1,450	Clears 9' path	Use on 90-120 hp truck.
" "	" "	2410 MRT 2410 PRT	24" x 10'	1,470 1,550	Clears 10' path	Use on 100-150 hp truck.
" "	" "	3010 MRT 3010 PRT	30" x 10'	1,570 1,670	Clears 10' path	Use on 120-175 hp truck.
" "	" "	3611 MRT 3611 PRT	36" x 11'	1,695 1,790	Clears 11' path	Use of 175+ hp truck.
Sound suppressor, portable	Air Logistics Corp.	11,000	194" x 92" x 72"	8,000	Noise reduced 40db inside radius of 50'	Adaptable to any jet aircraft configuration.
Starting system, automatic	Consolidated Diesel Elec. Corp.	4000	Each unit 110" x 36" x 60"	5,000	60kw, 120/208v.—60n	Gap filler radar power supply units.
Sweeper	Wayne Manufacturing Co.	1-550	9'1" x 16'6" x 105"	11,500	Sweeps path 7'6"	Hopper capacity 4 cu. yd.
Sweeper	Wayne Manufacturing Co.	2-550	9'1" x 16'6" x 105"	12,500	Sweeps path 10'	Hopper capacity 4 cu. yd.
Sweeper	Wayne Manufacturing Co.	1-450	9'1" x 15'8" x 83"	10,000	Sweeps path 7'6"	Hopper capacity 3 cu. yd.
Towing tractor, "paymover"	The Frank G. Hough Co.	T-50	126" x 66" x 57¼"	6,650	5,000 lb. drawbar pull	For corporate type aircraft.
" "	" " "	T-60	126" x 66" x 57¼"	7,750	6,000 lb. drawbar pull	DC-4, Convair 440.
" "	" " "	T-120-F	143" x 80" x 60"	13,700	12,000 lb. drawbar pull	DC-7, DC-6, 1049 Constellations, Boeing 377; 4-wheel drive.
" "	" " "	T-150	135" x 96" x 54"	22,000	15,000 lb. drawbar pull	DC-7, 1049 Constellations, WV-2.
" "	" " "	T-300S	189" x 92" x 60"	40,000	30,000 lb. drawbar pull	Applicable to "707," DC-8, B-47, & B-52; 4-wheel drive, power shift, steer, brakes.
Turntable, compass rose	Wakefield Engineering Co.	Type B-1	37" dia. x 6"	125	40,000 lbs.	Single-wheel gear.
Turntable, compass rose	Wakefield Engineering Co.	Type B-2	77" dia. x 10"	750	100,000 lbs.	Both single- & dual-wheel.

Sit-down, self-propelled power supply



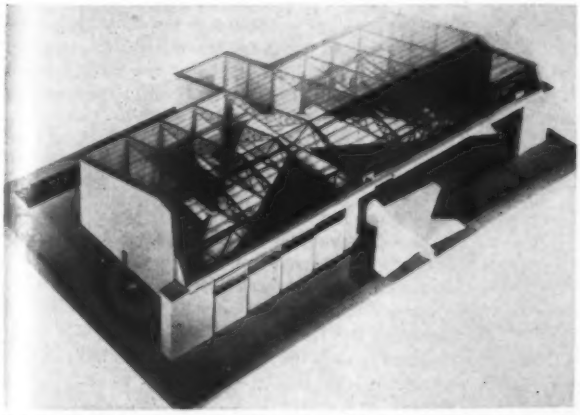
GROUND POWER UNIT built by Motor Generator Corp., Model 3040, measures 127-7/32" x 64" x 58", weighs 4,175 lbs. The vehicle, used for servicing Viscounts, contains a 33-kw generator (1,000 amperes at 33v) and will generate 50 kw for six 10-sec. peaks with 60-sec. intervals between peaks.

Transit case for communications equipment

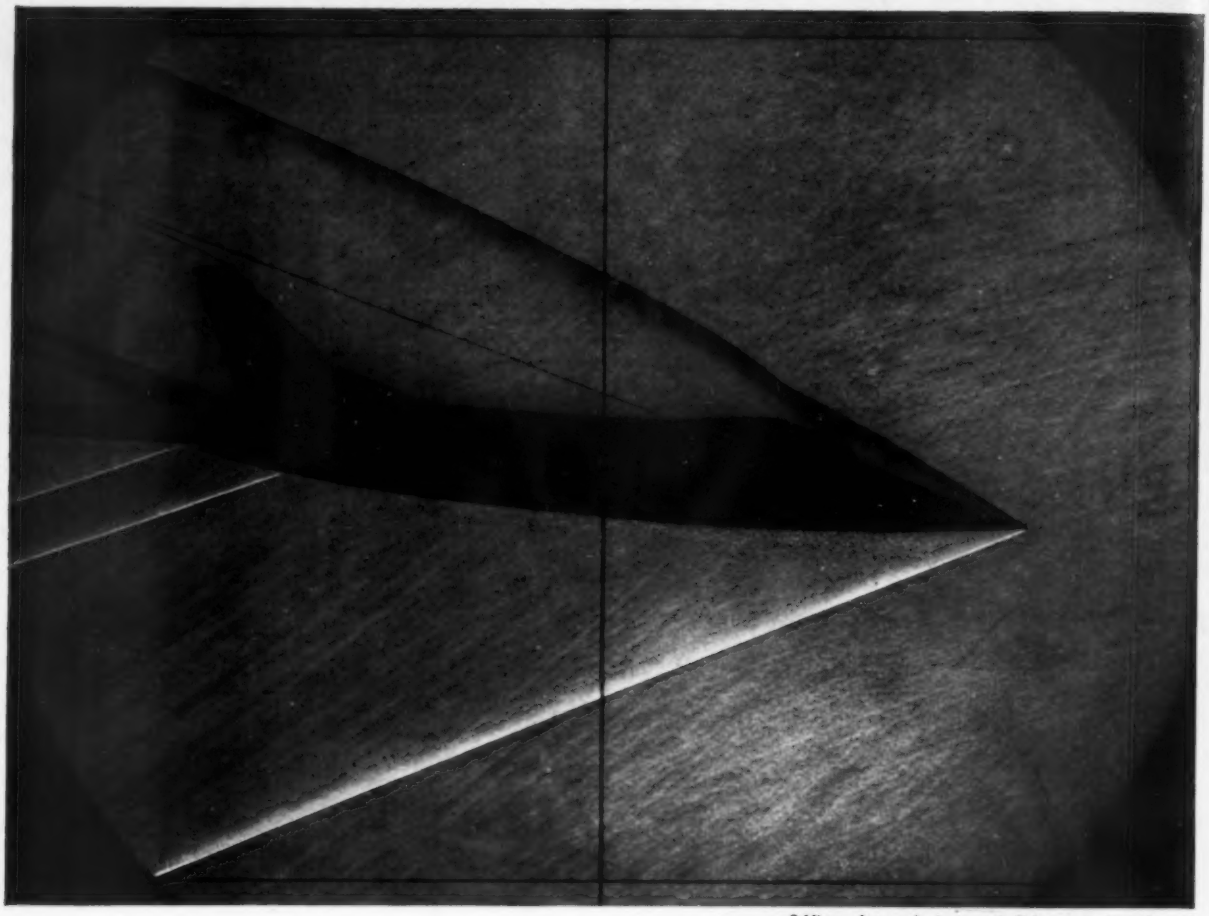


ROBINSON AVIATION, INC. offers a transit case designed to protect airline communication and navigation equipment during return-to-overhaul shipment. Metal mounts, canted angularly at corners, provide effective center-of-gravity suspension system.

Maintenance dock for Air Force



NEW CONCEPT in maintenance of large jet bombers and transports is demonstrated by this special steel structure designed by Luria Engineering Co. for the Air Force. Building features fast, easy erection at low initial cost, assures protection for ground crews. Note extension to accommodate nose of Boeing B-52 bomber.



Schlieren photograph of supersonic flight patterns in wind tunnel.

There is a formula for supersonic supremacy

Supersonic supremacy is the absolute condition of America's future security. It is a day-to-day thing. It must grow with major new advances; it must be strengthened by aircraft that fly much faster, much farther and higher.

North American Aviation's vast backlog of experience in the design and production of supersonic aircraft—by far the greatest in the Free World—is concentrated on this unending challenge. There are sound reasons for North American's ability to design superior aircraft with certainty—and to turn them into hardware with speed and economy:

North American designs for performance. The supersonic F-100 Super Sabre exceeded the speed of sound on its first flight in 1953. And there is still no Air Force operational airplane that can match the F-100's tactical and combat versatility, or its endurance—proved by record-breaking non-stops: London to Los Angeles, Los Angeles to New York, and New York to Paris.

North American designs for production. From the beginning, North American's engineers have designed every airplane for rapid, low-cost production. That is why North American can turn a new weapons system concept into a flying reality in the shortest possible time.

North American designs for growing potential. From the basic F-100 design came a brilliant series of new versions—the F-100A, C, D, and F—all adapted to special duties without sacrificing speed, range, altitude, or payload ... or spending the years and millions normally required for new designs.

North American designs for the future. The X-15 rocket plane, now in production, will carry man higher and faster than ever before. Other major supersonic projects now in advanced development include a long-range interceptor for the Air Force at North American's Los Angeles Division and the A3J, a carrier-based attack weapon system for the Navy, at the Columbus Division.

The formula for supersonic supremacy in the future is supersonic experience today. North American has it.

NORTH AMERICAN AVIATION, INC.

Los Angeles, Fresno, Canoga Park, Downey, California; Columbus, Ohio; Neosho, Missouri.

NORTH AMERICAN HAS BUILT MORE SUPERSONIC AIRCRAFT THAN ALL OTHER COMPANIES COMBINED

Air Force details $20-million machine tool program

Numerical control systems to be used for contouring machines, with more than 100 slated for operation by 1959

by Richard van Osten

LOS ANGELES—Details of the several numerical control systems to be used in the Air Force's $20-million machine tool program and numerical control systems in general were featured in the Electronic Industries Assn's first technical symposium on this subject.

The meeting included representatives of the Aircraft Industries Assn., National Machine Tool Builders Assn., National Electrical Manufacturers Assn. and the Office Equipment Manufacturers Institute.

The AF's program centers around contouring machines for such purposes as skin milling or for cutting large and complex shapes in research and development. Numerical control systems for these machines are being manufactured by Giddings & Lewis Machine Tool Co., Electronic Control Systems, Inc., Bendix Aviation Corp., General Electric Co. and Cincinnati Milling Machine Co.

More than 100 of the machines will go into operation between now and 1959, with lead time varying between 12 and 24 months, depending upon the complexity of the equipment.

Large gains in offing

All five of the above systems involve some form of punch card, punched tape or magnetic tape for machine control. It is claimed that data-processing for the machines' input may be done in a relatively few minutes.

In the opening speech, Lt. Gen. C. S. Irvine, USAF deputy chief of staff-materiel, told the symposium that numerical control offers the greatest possibility for relatively large gains in production of quality hardware and potentially large money savings.

Gen. Irvine said the AF is convinced that use of the numerical control system can eliminate much costly tooling such as templates, provide absolute uniformity in duplicated pieces, increased reliability of tooled parts and perfect translation of engineering intent into finished pieces.

The advantage of less labor cost per item may also be realized, the general noted, as experience is showing that numerical control increases the production rate from 3 to 1 in some cases to as high as 20 to 1 in others.

Ralph E. Cross, executive vice-president of The Cross Co., Detroit, said new numerically controlled machine tools will make obsolete many machines now considered profitable investments. Extent of numerical control applications will depend upon the size and complexity of the product and on the cost of numerical control.

Cross placed milling machines at the top of the list for numerical control—particularly such types as skin mills and milling machines for various types of contour milling on large and complex shapes. This is because operations on these machines are usually quite involved and parts are put through in comparatively small quantities. In addition, the cost of the machine itself is large enough so that the extra cost for numerical control can be more easily absorbed.

The next most probable use of numerical controls, he said, would probably be at the other extreme—machine tools such as boring mills, jig borers, drill presses, etc., where the numerical control is used for positioning only. This is a comparatively simple and inexpensive arrangement, and may be applied, under certain conditions, for high production rates.

Rough estimates from authoritative sources, Cross said, show that there are a total of 1.7 million machine tools in use today which could be improved by the use of numerical control.

He pointed out, however, that there are problems, especially concerning some of the unrealistic and fantastic claims made for numerical control.

"There has been altogether too much talk about pushbutton factories, giant brains and million-dollar computers. These high-sounding phrases make good newspaper copy, but they scare the pants off the average person who is interested in buying machine tools."

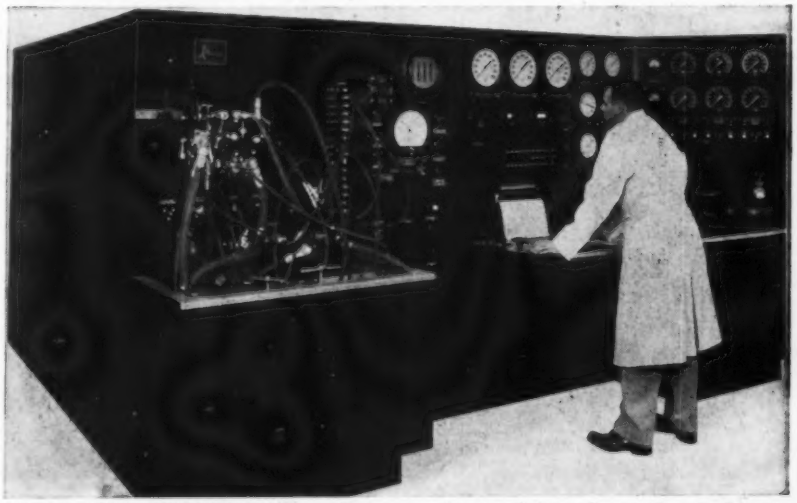
Confidence most effective tool

Cross also condemned claims that the operator could be eliminated as indicative of "a lack of understanding of shop conditions."

"I doubt if you could find a customer who would even think of buying a machine tool that doesn't need watching. There are just too many problems that can't be anticipated and provided for. The most important thing to be remembered is that these fantastic claims destroy buyer confidence and, as every machine-tool builder knows, confidence is the most effective tool available when it comes to selling a new idea."

Another problem to be overcome is the impression that numerically con-

Test stand for jet-engine fuel controls



AUTOMATIC CHARTING of performance characteristics of complex hydro-mechanical fuel controls used on jet engines is accomplished by Nankervis test stand. Use of stand is said to result in a time savings of 30%. Designated Model 7930 unit measures 12 ft. square and is self-contained except for a motor generator set.

Northrop to use tape-controlled millers

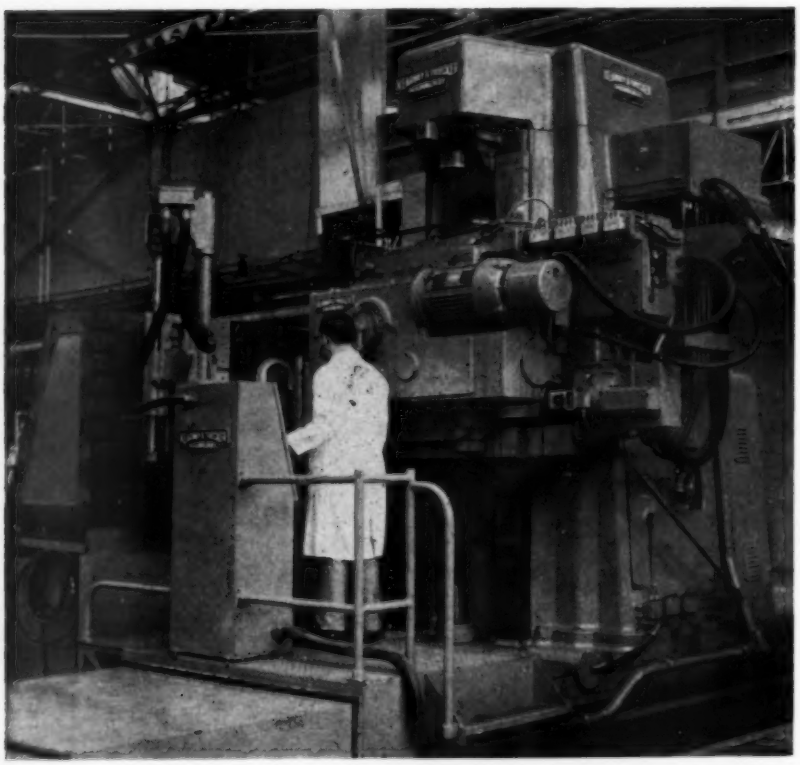
Northrop division of Northrop Aircraft has announced that it will have three Kearney & Trecker tape-controlled profile milling machines in operation by the end of 1957.

Part of the Air Force's long range plans to obtain advanced weapon systems more economically, the numerically controlled machines use an electronic "brain center" developed by the Bendix Computer division of Bendix Aviation.

Northrop expects to employ the machines in its guided missile and manned aircraft program, including the SM-62 Snark, the T-38 supersonic trainer and subcontract work on other missiles and aircraft.

KEY to speed and efficiency of Northrop's Kearney & Trecker miller is laminated aluminum and plastic Mylar tape.

CONTROL CENTER developed by Bendix Computer Div., Bendix Aviation Corp., features packaged electronics for ease of maintenance.



54-TON Kearney & Trecker profile and contour miller in operation at Northrop Aircraft, Inc. is controlled by thin, one-inch wide tape. Installation is part of USAF long-range program to step up production of precision parts for advanced weapon systems with significant gains in economy.

(Continued from page 91)

trolled machine tools are overly complicated and expensive. Cross said that the responsibility for this impression probably lies with the machines developed under the Air Force's guidance. These machines are very complicated and expensive, he said, because they were designed to perform very large and intricate work.

Other problems to be eliminated are such things as the notion that *all* numerically controlled machines require elaborate programming techniques, skilled crews of programmers and complicated backup equipment. Cross said that programming for automatic machines is not new, citing the personnel required for screw machine programming.

Summing up, he pointed out that numerical control is not a "gadget" to be attached to machine tools—the machine and the controls must be completely integrated.

"No one should be able to tell where the machine stops and the control starts," he concluded.

George E. Kinney, chief equipment engineer for the aircraft division of Hughes Tool Co., reported that the Aircraft Industries Assn.'s subcommittee for numerical controls is somewhat different than other similar groups.

Emphasis on standardization

Although the subcommittee is heavily engaged in a standardization program, it is concerned with numerical controls systems from the users' point of view. It has not, and will not, he said, recommend specific systems nor will it tell systems' builders how to build their systems.

The subcommittee is emphasizing standardization for three reasons: (1) the reluctance of the aircraft industry to accept any less interchangeability than exists at present; (2) the problems encountered in establishing a degree of standardization between contractor and sub-contractor, and (3) the degree of compatibility made necessary by the government's mobilization day requirements.

Three standardization projects are being worked on by the subcommittee in cooperation with EIA committees. One is the analysis of tape language and tape itself, both magnetic and punched. Another is an analysis of the economics of interpolator location including the question of whether it should be located in the office or attached to the machine. And a third is the development of machine performance specifications, including cutting and acceptance tests.

The problems of data processing are being explored by the subcommittee in order to make an early economic use of numerical control machines. One training course has been given at Massachusetts Institute of Technology, which was attended by approximately 60 programmers and technicians from various airframe plants. An additional

program is under way between MIT and the subcommittee's member companies to develop sub-routines for numerical programming using an IBM 704.

Kinney said the subcommittee realizes that as the economics of numerically controlled machines begin to show advantages, there will be a desire to adapt existing tools for the control systems. Work in this area is being coordinated with the Stanford Research Institute, he said.

Edward E. Kirkham, project engineer for Pratt & Whitney, Inc., described some control systems developed and manufactured by British firms.

The Ferranti Co.'s system was declared to be "very remarkable" in that it uses an optical measuring system which is scanned photoelectrically. The photocells deliver pulses for each increment of travel on each slide. This concept provides a transducer entirely free of wear and not subject to deformation by forces applied by the power drive. The Ferranti system also uses a special purpose computer, operating from perforated tape.

The Mullard Autoplot machine, developed in England, is a complete drilling machine which measures feedback by means of phototransistors detecting the passage of light through a perforated tape.

Another English system, developed by BTH, was described as being similar to Pratt & Whitney's system for jig borers and jig grinders, except that it uses a synchro feedback rather than a potentiometer feedback.

Kirkham also described several American systems that are not among those purchased by the Air Force, or otherwise detailed during the symposium.

NAA development similar

North American Aviation's Autonetics division has independently developed a system similar to the Ferranti optical transducer, but then expanded the system to include interpolation at the machine tool so that the control tape does not contain interpolated data. The machine control is completely transistorized, thus providing an extremely compact installation at the machine tool.

Kirkham went on to describe briefly approximately 23 other numerical control systems for contouring and positioning, but, in his own words:

"There are literally dozens of such systems and a complete description of each one might become the subject of an entire paper in itself."

The 1957 symposium was the first of its kind and most of the attendees agreed that it will become a permanent arrangement. Hope was expressed by several that the 1958 symposium will find representation from England and other nations interested in advancing the art on numerical machine controls.

TEMPERATURE ACCELERATION INDICATOR
Mfr.: Lycoming Div., Avco Mfg. Corp.
Size: 8¼" x 8¼" x 13⅛"
Weight: 23 lbs.
Ratings: From 18 mv to —4.5 mv at input terminals, 600°F to —150°F.
Remarks: Calibrated to indicate temperature change of 150°F. Accuracy ±10°F.

RECORDING OSCILLOGRAPH
Mfr.: Consolidated Electrodynamics Corp.
Model: 5-122
Size: 18½" x 11" x 8"
Weight: 80 lbs.
Ratings: 26 channels; 12,000 ips
Remarks: Unit occupies 1 cu. ft. Provides timing identification. Sustains 15 shock forces.

RADAR TEST SET
Mfr.: Sperry Gyroscope Co.
Model: 590-B (Mil UPM-44B)
Size: 16¾" x 18¼" x 16¼"
Weight: 75 lbs.
Ratings: Freq. 2700-3500 mc; Power Range +5 to +30 dbm; Signal Range 0 to —100 dbm.
Remarks: For airborne monitoring of early-warning radar in picket aircraft.

LIQUID LEVEL SENSOR
Mfr.: Acoustica Associates, Inc.
Size: Probe 1½"x11/16" cia. Control unit (shown): 3.44" x 1.5" x 1.5".
Weight: Probe 1 oz. Control unit 6 oz.
Ratings: Probe 100g shock; control unit 15g shock.
Remarks: For conventional aircraft fuel tanks and liquid fuel missiles.

PHASE MEASUREMENT OSCILLOSCOPE
Mfr.: Waterman Products, Inc.
Model: PIA 5x5
Size: 5¼" x 5-3/6" x 10"
Ratings: 7 mv per inch-vertical; 10 mv per inch horizontal.
Remarks: Panel mounting scope for phase measurements and other Lissajous patterns.

SYNCHRO/SERVO TESTER
Mfr.: Aero Electronics Co.
Model: MG-1
Size: 6" x 10½" x 12"
Weight: 10½ lbs.
Ratings: 26 v. 400 cycles, single phase. Stator output 11.8 v.
Remarks: modified versions can be supplied on special order.

Product data -- tools & maintenance equipment

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Accelerometer, Counting	Research, Inc.	4027	1" dia. x 1"	0.3	0 to 12 g	Flight test struct. load data.
Altitude-temperature test chamber	Mantec, Inc.	AT-102	(alt. chamber) 30 x 18 x 21 (test chamber) 34 x 22 x 25	1,000	-100°F to +400°F. temp. 200,000' altitude	For testing aircraft parts.
Blower unit	United Mfg. Co.	PBU	42" x 42" x 42"	600	1,000 cfm at 12" water when operated at 2,790 rpm, 4.9 bhp .1800 cfm at 12" water when operated at 2,500 rpm, 6.5 bhp.	Supply air to aircraft heaters for ground checks.
" "	" " "	Type MC-1				" " "
Bridge, capacitance	Daystrom Instruments		25" x 26" x 18"	99	25 to 8,000 uuf accuracy of .1% or .2 uuf	Frequency-sensitive type.
Calibrator	Allegany Instrument Co.	C			All were strain transducers and thermocouples	
Centrifuge, high speed	Warren Bros. Roads Co.	SC-300	variable		30,000 "G"	Centrifugal testing of electronic devices or components to high "G."
Check-out, bombing system	Sperry Gyroscope Co.	201	semi-trailer		15 min. for 3,500 signal checks	Field test equipment for supersonic aircraft bombing system —preflight.
Check-out, bombing system	" " "	250	8' x 6' x 30"		30 sec. per system	Flight line test-bombing system.
Check-out, missiles	" " "	101	relay rack 22" x 17" x 7"		90 sec. to test 180 channels	Tape programmed, used for long-range missile tests.
Circuit tester	Multi-Amp Corp.	1004/44 60CA	16½" x 16" x 9¾"	approx. 40 lbs.	.4 kva 110 volt 60 ac	For testing circuit breakers aboard planes.
Cleaner, spray	Aeroil Products Co.	MA-1	7' x 3' x 4'	1,500	120 gal. 60 psi	Spray clean aircraft.
Cleaner, ultrasonic	Branson Ultrasonic Corp.	AP 50	14" x 18" x 14"	65	250 watt	Ultrasonic cleaning.
" "	" "	AP 200	25" x 17" x 19"	175	1 kw	" "
" "	Branson Instruments, Inc.	14	14" x 14" x 23"	60	Thickness range .005"-2.5"	Non-destructive thickness gaging with recording.
Computers, heat transfer	Research, Inc.	4004	various	various	n/a	Hi temp. testing of a/c & missiles.
Counter, integrating	Allegany Instrument Co.	270			10,000 counts per sec.	Integrates value of any analog-time signal.
Cylinders	Dynex, Inc.		1" dia. to 4" dia.		To 6,000 psi	Ground support & dollys.
De-icer & cleaner	Aeroil Products Co.	MB-4	15' x 7'6" x 6'	7,000	35 gal/min-150 psi	De-icing & cleaning parked aircraft.
Drum-jet	Industrial Washing Machine Corp.	D-J	25' x 8' x 12'	30,000		For cleaning screw machine products used in aircraft industries.
Echoscope	Curtiss-Wright Corp., Industrial/Scient. Prods. Div.	501	20" x 12" x 16"	65		For contact testing of plate extrusions, forgings, etc.
Electrodes, Arcair	Arcair Co.	Grade N	dia. 5/32"-½"			Carbon graphite electrodes for use with torch.
Engine Analyzer	Kistler Instrument Corp.	EA 114	20" x 12" x 14"	35	Measures compression combustion, fuel injection, manifold pressures, detonation, preignition, vibration and ignition	Aircraft piston & compound type engines.
Engine Indicator, M.I.T. High-Speed, Recording	American Instrument Co., Inc.	5-1711	25" x 11" x 18" in carrying case	175 net	0 to 5,000 rpm 2,000 psi sensitivity ±1% of full scale	For internal combustion aircraft engines.
Engine, Indicator	" "	5-1716	26" x 16" x 14"	95 net	0-3,000 rpm—1,000 psi	Testing internal combustion aircraft engine.
Exhaust probe	" "	10-401 10-402	5" x 4" x 3" w/15" long probe	4	Coating thickness measurements: from 0.015 to 0.10 in.	Inspection of aircraft exhaust systems; inspection of metals measuring coating thickness and wall thickness.
Feedback Test Stand	United Mfg. Co.	ATS	console, 60" x 30" x 67"	4,000	90 kva	Testing of 3-phase systems.
Filter	Poroloy Equipment, Inc.	1314	18" x 24" x 48"	600	600 gpm	
Filter, High Pressure	" "	1268	14" x 6" x 18"	150	Flow to 20,000 scfm @ 3,000 psi; 3,000 and 5,000 psi operating pressure	
Filter, Liquid Oxygen	" "	1304	36" x 12" x 12"	100	1,000 gpm LOX @ 2 psi pressure drop; available for flow rates to 5,000 gpm	
Filter, Test Stand	" "	1346	9½" x 3½" x 4½"	3	12 and 24 gpm of MIL-O-5606 to 20,000 psi burst; aluminum or stainless steel	
Flaw calibrator	Curtiss- Wright Corp., Industrial/Scient. Prods. Div.	429	24" x 17" x 15"	150		Monitors, measures flaws.
Force gage mechanical	Hunter Spring Co.	Series D-M	12" x 3½" x 3¼"	8.5	0-50, 0-75, 0-100, 0-150, 0-200 lbs.	Service & test on control systems.
" "	" " "	Series L-M	8" x 2" x 1¾"	1.8	13 ranges from 0-5 kg to 0-30	" " "
Frequency meter, heterodyne type	Lampkin Laboratories, Inc.	1058	10" x 6" x 5"	12.5	100 kc to 175 mc accuracy .005%	For checking frequency, radio transmitters.
Fuel-gauge tester	Daystrom Instruments		12" x 8" x 10½"	24	Capacitance 0 to 5,000 uuf resistance .5 to 1,000 ohms	Electronic.
Generator Signal	BJ Electronics	75	17¾" x 19½" x 20"	85	10 to 440 mc	Aircraft test equipment.

Product data - tools & maintenance equipment

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Generator, Signal	BJ Electronics	82	18" x 19" x 10 7/16"		20 to 3,000 mc by 5 plug-in RF assemblies	Aircraft Test equipment
Generator test stand	United Mfg. Co.	MDS type 25A	92" x 36" x 42"		10,000 to 20,000 rpm	Drive high speed aircraft and missile type AC or DC generators.
Ground portable analyzer	Land-Air, Inc.		14.5" x 10.5" x 12"	41	Vibration or ignition analysis	For reciprocating engines to MIL-A-19129 (Aer), 9207B (USAF).
Gyro test table	Gruen Electronic Products	A100	37" x 40" x 37" 24" table	1000	Variable velocity .01 to 100 degrees/sec. accuracy ±.05%	Precision measurements on inertial systems; crystal controlled.
Hand pumps	Dynex, Inc.	PF-3000 P-146; P-148;	approx. 10" x 8" x 6"	15 to 30	2,500 to 6,000 psi .14 to 3 cu. in./stroke	Single & double acting pumps.
Hardness tester	Advanced Electronics, Inc.	A-300		8		High voltage insulation tester.
Hardness tester	Torsion Balance Co.	MC-2	15" x 15" x 28"	160	8" vertical; cap.—700-900 pcs/hr	Hardness testing of parts.
" "	" "	AC-2	15" x 15" x 32"	200	6" vertical; cap.—800-1,000 pcs/hr	" "
Heaters radiant	Research, Inc.	ALT-8-612	6" x 12"	3	50 kva/ft²	Hi temp structural testing of a/c & missiles.
High potential tester	Behlman Engrg. Co.	578	19" x 12" x 14"	30	0-15,000 volts dc	Insulation tester for ground support.
Hydraulic test cart	United Mfg. Co.	PHC type 208NS	110" x 58" x 78"	4,300	20 gpm of Skydrol fluid at 3,000 psi continuously, 5,000 psi at reduced flows.	Check aircraft hydraulic systems and aircraft hydraulic system components in final assembly and pre-flight areas.
Ignition test set	Paschel Electronics, Inc.	CT-0	22" x 16" x 15"	50.	Portable 10 kv @ ¼ kva	Test wiring, ignition hardness, plugs, etc.
Immerscope	Curtiss-Wright Corp., Industrial/Scient. Prods. Div.	424A	27" x 16" x 18½"	160		For ultrasonic immersed testing of plate, extrusions, forgings, etc.
Ingnitron power controllers	Research, Inc.	6146	24" x 22" x 72"	800	380 kva	Hi temp testing of a/c & missiles.
In-Line digital display	Industrial Electronics Engrs.	10000	5⅛" x 1 9/16" x 2⅝"	.75	From 6.3 v to 48 v	Ground control equip. equip. test controls.
Insulation tester	Janco Corp.	1700	29" x 10" x 19"	100	110 v 60 cps power	For testing wiring insulation to MIL specs.
" "	Paschel Electronics, Inc.	H5AC/DC H20AC/DC	8" x 14" x 8" 15" x 22" x 15"	35. 80.	5 kv dc/Peak ac 20 kv dc/Peak ac	Test wiring, ignition harness, plugs, etc.
Invertron	Behlman Engrg. Co.	Various	Various	100-800	40 va to 3 kva	AC power supply for ground support.
Magnaflux	Magnaflux Corp.	KCH-3D	42" x 32" x 40"	800		Locates surface & subsurface defects—aircraft overhaul.
"	" "	K-06	8½" x 12" x 18"	37		Locates surface cracks in ferrous metals.
"	" "	KH-05	18" x 26" x 34½"	195		Locates surface and subsurface cracks in ferrous metals.
Magnaflux yoke kit	" "	Y-5 YM-5	15" x 5" x 10" 15" x 5" x 10"	22¾ 22		Locates surface cracks (local areas) in ferrous metals.
Magnatest	" "	FM-100	15" x 8" x 11"			Measures conductivity.
"	" "	ED-500				Locates cracks in spark plug parts in aluminum aircraft cylinders.
Magnetometer	Irwin Laboratories	M-6	7½" x 8" x 9"	8	0.5 to 1,000 milligausses	Testing for residual magnetism in parts.
Magneto timing light	Advanced Electronics, Inc.	A-100	6" x 2½" x 3½"	3		Synchronizes magnetos in piston aircraft.
Marking machine (wire)	Kingsley Stamping Machine Co.	KW-6	19" x 23" x 14"	100		Motor driven.
" "	" "	KWH-2B	12" x 8" x 13"	15		Hand operated.
Marking machine (wire & tube)	" "	KTE	12" x 8" x 13"	17		" "
Marking & cutting machine (tube)	" "	KTL-1	12" x 13" x 13"	20		" "
Metal analyzer (Induflux)	Irwin Laboratories	MA-3	15" x 22" x 19"	125		Jet engine part testing for service life.
Meter, tension	Tensitron, Inc.		6" x 3½" x 1"	1.7	0-1,000 gr.	For precise potentiometers, coils, other wire-wound products
Micro-punch	Moran Instrument Corp.	251-C	3¼" x 2" x 5¾"	2¼		Templates, layout, scribed height, gauge lines.
Multiplier	" "		7⅝" x 3" x 3¼"	5		Used in aircraft & missiles to give resolutions as to air speed & altitude.
Piston pumps, high pressure	Dynex, Inc.	PF-3000 PF-6000		25 to 150	3000 psi 0-50 hp 6000 psi 0-100 hp	Test stands & missile dollys, etc.
Power supply, portable AC	American Electronics, Inc.	EPM-1120 EPM-1123	16½" x 29" x 48"		Output ac-5kva at 0.9 pf Output ac-3kva, at 0.9 pf, 5 hp input	For laboratory testing.
Power supply, portable	Weldmatic Division	1016	13⅝" x 8¼" x 61"	20	40 watt second	Used for thermocouple and strain gauge welding in aircraft industry.
Power supply, stored energy	" "	1027	16½" x 23½" x 25"	104	250 watt second	" " "
Pyrometer	Epic, Inc.		3" dia.	1	400°F	Needle type for measuring temperature of aircraft tires.
Signal generator	H. J. Burke Co.	Ts67	21" x 13" x 16"	65	RF generator	For testing localizer and glide path receivers.

ROTOL PROPELLERS

ON VICKERS VISCOUNT AIRCRAFT

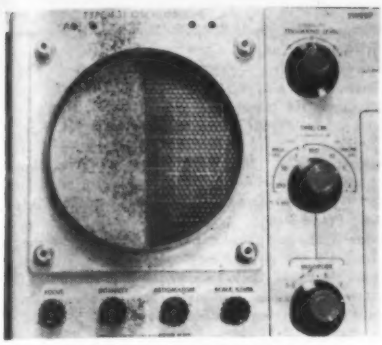
Over New Orleans

Product data - tools & maintenance equipment *(Continued)*

Item	Manufacturer	Model	Dimensions (LxWxH)	Weight (lbs.)	Ratings	Remarks
Spin test unit, horizontal	Warren Bros. Roads Co.	HHS-I	variable		To 15,000 rpm	Overspeed jet engine rotors.
Synchro instruments tester	Aero Electronics Co.	Type C-I (Field)	6" x 6" x 10½"	6½	Operating temp. -20° to +55°C	Includes calibration table listing data of 182 commonly used pressure and fuel flow instruments.
Synchro/servo tester	Aero Electronics Co.	Type MG-I	6" x 10½" x 12"	10½	Operating temp. range: -40°C to 55°C	Accuracy of synchro and servo transmitters is 0.3° (max.).
Test set	H. J. Burke Co.	T-1008	12¾" x 14" x 13"	40	RF generator	For testing ARN-6, ARN-7 radio compass.
Test set	H. J. Burke Co.	Ts-173	7" x 7¾" x 15"	14	RF generator	Localizer test set.
Thermal conductivity test console	Parameters, Inc.	140-A	4' x 2½' x 6'	425	To coefficients of thermal conductivity of 5.0 btu/ft²-hr-°F/in.	For testing materials to be used as thermal insulation in aircraft and missiles.
Torch, Arcair	Arcair Co.	H-3	10½" x 2" x 4"	7	100# pressure	For cutting or gouging metals.
Tracking light	Research, Inc.	6039	3" dia. x 12"	5	2 flashes/sec., hi. intens.	Tracking target drones; visual & photo aid.
Transducer, vibrotron digital	Borg-Warner Corp.		miniature	2 oz. to 1 lb.	0-50 to 0-2,000 psia and psig; RDB channels	For aircraft & missile test equipment.
Tube bender	Pacific Specialty Mfg. Co.		8" (std. length)			Tool can handle 3/8" dia. steel, ¾" dia. aluminum. Bend: ¾" to 5" radius; 360° angular rotation; 180° bend.
Tube tester	Seco Mfg. Co.	107	13½" x 6" x 9"	14½		Fast, accurate vacuum tube tester.
Ultrasonic cleaner	Acoustica Associates, Inc.	DR-50 AH	Tank: 6" x 6" x 6" Generator: 8" x 10" x 10"	40	40kc, 50 watts, 200 watts peak, 115v, 60 cps	Maintenance of carburetors, plugs, relays, injectors.
Ultrasonic washer	Curtiss-Wright Corp., Industrial/Scient. Prods. Div.	WB2-5	25" x 14½" x 16"	130		For small parts cleaning.
Ultrasonic degreaser	Curtiss-Wright Corp., Industrial/Scient. Prods. Div.	DB2-25	48" x 24" x 22"	475		Cleans and degreases in vapor.
Vacuum pressure tester	Intercontinental Dynamics Corp.	VPT-7A	16" x 13" x 15"	57	29½" mercury-vacuum; 50 psi pressure	For flight instrument systems.
Vacuum pumps	Nelson Vacuum Pump Co.	series "900"	13" x 10½" x 12"	36	Capacity; 24 liters; vacuum 0.01 mm.	Use in altitude simulation, & test instruments.
Valves	Research Controls	type SUBM	5⅛" rd. 9" h.	4	4,000" throttling -40° to 165°F	Submerged methanol test cell valve.
"	Research Controls	type BA1209 &BA1192	6½" rd. x 15"	12		Missile launching sta. Auxiliary equip. Helium and air.
"	Research Controls	type 75	various		4,000 psig	Instr. operated diaphragm control valves.
Vibrograph, hand	Epic, Inc.	1606	10" x 5½" x ¾"	3¾	250 cps	Measures vibrations in aircraft.
Vibrograph, universal	Epic, Inc.	1635A	6" x 7" x 9"	28	10g	Measures vibrations in aircraft.
Washer, parts	Aeroil Products Co.	TA-PC-30A	53½" x 24" x 45½"	240	circulates 120 gph 10 gal. cleaning tank	Small parts cleaning air agitated.
Washing machine, engine	Industrial Washing Machine Corp.	OM 42 x 42 W-R-D	45' x 6' x 8'	30,000		For cleaning engine parts after tear down.
Welder, precision resistance	Weldmatic Division	1015	24" x 9½" x 18½"	20	40 watt second	Used for thermocouple and strain gauge welding in aircraft industry.
Welding torch, inert gas shield	Wilson Equipment Corp.	10 straight 12 angle	head 1¾"		To 150 amps	
Windtunnel	West Coast Research Corp.	966-I	7" x 10" test sect. 10' x 6' x 2'	600	200 knots and up	"Do-it-yourself" tunnel for laboratory, engr. office and class demonstration.
X-ray unit	Triplett Barton, Inc.	Tri-Ind-X	50" x 27" x 52" hsg. 36" x 11" dia. head	1,100 65	275 kvp	X-ray inspection of aircraft.

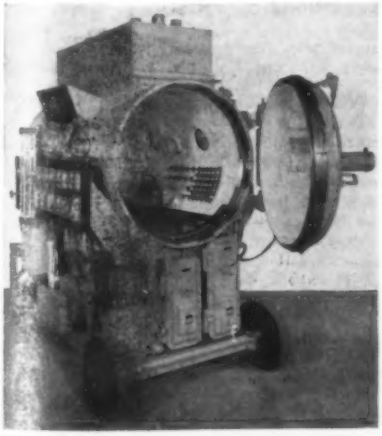
Extra copies?

For additional copies of this Engineer's Handbook of new products, materials and equipment, write to American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D. C. Attn. L. L. Brettner, Circulation Director. Price is $2.00 per copy.



OSCILLOSCOPE ACCESSORY
Mfr.: Van-Dee Products
Remarks: A shadow screen that fits scope face. Blocks out ambient light when scope is used outdoors or in bright room. Contrast increased 20 to 1. For 3" or 5" scopes.

IGNITION ANALYZER KIT
Mfr.: Heath Co., subsidiary Daystrom, Inc.
Remarks: Model IA-1 kit to build unit for testing spark systems on internal combustion engines. Checks dynamic performance from 400-5,000 rpm.



ALTITUDE EXPLOSION CHAMBER
Mfr.: Janke & Co., Inc.
Size: 8' x 5' x 10'
Weight: 8,000 lbs.
Ratings: sea level to 80,000 ft.
Remarks: controlled explosions in chamber or inside test items.

Other product sources and services

Air cleaners, electrostatic—Radex Corp.; for laboratories where airborne contaminates, particles, dust must be kept to minimum.
Air hoists—Gardner-Denver Co., Keller
Assembly stand, jet engine—Colson Corp., Sub. of Great American Industries, Inc.; vertical stand for P&W J57 assembly. Tool Div.; 300 to 4,000 lbs.
Bridge, capacitance—Daystrom, Inc.; For primary standard use.
Bridge, inductance—British Industries Corp.; Model AC1100 direct-reading inductance bridge.
Calibration stand—Brooks Rotameter Co.; comparison-type rotameter calibration stand for testing rotameters and other flow devices.
Carbon removal compound—Trio Chemical Works, Inc.
Circuit Analyzer—DIT-MCO, Inc., Electronics Div.; automatic pushbutton circuit analyzer that tests 144 circuits.
Computer services—Alwac Corp., aerodynamics, scientific design and research, general computation, network analysis, preliminary design, surveying, meteorology, tabular data.
Counting unit—Computer Measurements Corp.; decade lamp type for 40,000 to 100,000 cps. Drafting templates—E. F. Twomey Co.
Data reduction systems—Consolidated Avionics Corp.; transducer calibrators (Model 228) and precision frequency meters (Model 200).
Drop hammer—Chambersburg Engineering Co.; Cecostamp hammers.
Dye penetrant—Magnaflux Corp.; Spotcheck kit. electrical testing equipment; **Dollies**—Regent Jack Mfg. Co.; Davenport Mfg. Co.; transistor and tube power supplies.
Enclosures, instrument—Amco Engineering So.; for electronic and test equipment. Engine hoists, slings—Regent Jack Mfg. Co.; for jet engines.
Engine test cells—Janke & Co., Inc.; complete facilities for all aircraft engines, also semi-portable engine test facilities, ground-silencing equipment, thrust stands, fuel nozzle test stand.
Equipment cases—Skydyne, Inc.; Models 55100 to 55400 fibreglass-reinforced resin for electronic instrument and equipment cases.
Finishing machine, precision—The Heald Machine Co.; Model O Bore-Matic.
Fuel-gauge tester—Daystrom, Inc.; for capacitance and resistance; includes servo-driven self-balancing capacitance meter.
Grit blasting mixtures—Sirotta, Bernard Co.; ground nutshell pellets for soft blast-cleaning, used for carbon removal, etc., in engine overhaul shops.
Handtrucks—The American Pulley Co.; materials-handling trucks, also American Loadveyor.
Ignition system trainer—Systems Development, Inc.
Instrument tools—William Dixon, Inc.; tools and supplies used by watchmaking and jewelry trades.
Jacks—Regent Jack Mfg. Co.; portable alligator jacks, also crocodile jacks, axle jacks, tripod jacks, utility jacks.
Leak Detection System—Reed Curtis Nuclear Div., American Electronics, Inc.; aircraft and missile components.
Magnetic inspection units—The Ferroscope Co.
Manometers—Trimount Instrument Co.
Motion picture X-ray—Rototest Laboratories, Inc.; test of assemblies under environmental stresses.
Optical plumb aligner—Keuffel & Esser Co., for Vanguard assembly; assures assembly of 72-foot Vanguard within 0.25" of true vertical.
Optical tracking theodolite—H. A. Wagner Co.; RADOTT (Recording Angular Data Optical Tracking Theodolite) used in tracking airborne targets through nonphotographic means.
Plastic adhesives—Schwartz Chemical Co.; **Polishers for acrylics**—Schwartz Chemical Co.
Propeller servicing equipment—Taft-Pierce Mfg. Co.; propeller protractors, checking plates, balancing stands, reaming equipment, production equipment.
Radioactive materials handling—Nuclear Products, Erco Div., ACF Industries, Inc.; handling systems.
Remote controls, hydraulic—Tremount Instrument Co.
Retrieving tools—Robins Industries Corp.; tool picks pieces out of hard-to-get-at places.
Shock Tester—Consolidated Electrodynamics Corp.; high load simulation to 40,000 pounds.
Soldering aids—Erikson Specialized Tool Co.; available in kits, circuit tracers, solder reamers, wire brushes, knives and scrapers.
Spring coilers—Perkins Machine & Gear Co.; hand, power and variable speed coilers to handle wire from .005" to .125" dia.
Test bench—Skydyne, Inc.; flyaway model for aircraft and missile field testing; sandwich material construction.
Test cylinders—Regent Jack Mfg. Co.
Test cylinders, static—Regent Jack Mfg. Co.
Test lights—Speedex Mfg. Co.
Tire bead breakers—Regent Jack Mfg. Co.
Tool design—Engineering Div., Commercial Casting Co.; engineering, drafting.
Tools, diamond—Diamond Tool Research Co.; diamond cutting tools, diamond dressing tools, diamond powder, diamond compound, diamond wheels.
Towbars—Regent Jack Mfg. Co.
Ultrasonic delay lines—Arenberg Ultrasonic Lab., Inc.; for radar systems, MTI kits and integrators, digital computers.
Vacuum pumps—Leiman Bros., Inc.; for testing aicraft instruments and simulating high altitudes for testing purposes.
Wattmeter—Cubic Corp.; 0-600w for calibration of magnetrons and radar.
Wing seal—The Parker Appliance Co., Tube and Hose Fittings Div.; company also has tube fabricating equipment.
Wire strippers—Speedex Mfg. Co.
Zyglo Kit—Magnaflux Corp.; fluorescent inspection.

Directory of manufacturers

For additional information on products listed in this section, write to manufacturer at address below attn. sales manager. Give page number and refer to AMERICAN AVIATION ENGINEERS HANDBOOK of New Products.

Abrams Instrument Corp., 406 E. Shiawassee St., Lansing 1, Mich.
Acoustica Associates, Inc., Glenwood Landing, N. Y.
Advanced Electronics, Inc., 94 Silas Deane Highway, Rocky Hill, Conn.
Aero Electronics Co., 1512 N. Wells St., Chicago 10, Ill.
Aeroil Products Co., South Hackensack, N. J.
Airdraulics Engineering Sales Co., Allendale, N. J.
Air-Speed Tool Co., 1520 W. Slauson, Los Angeles, Calif.

Allegany Instrument Co., 1091 Willis Mountain, Cumberland, Md.
Alwac Corp., 13040 S. Cerise Ave., Hawthorne, Calif.
Amco Engineering Co., 7333 W. Ainslie St., Chicago 31, Ill.
American Electronics, Inc., 655 W. Washington Blvd., Los Angeles 15, Calif.
American Instrument Co., Inc., 8030-8050 Georgia Ave., Silver Spring, Md.
American Pulley Co., The, 4200 Wissahickson Ave., Philadelphia 29, Pa.
Arcair Co., P.O. Box 431, Lancaster, Ohio.
Arenberg Ultrasonic Lab., Inc., 94 Green St., Jamaica Plain, Mass.
Behlman Engineering Co., 114 S. Hollywood Way, Burbank, Calif.
B-J Electronics, Borg-Warner Corp., 3300 Newport Ave., Santa Ana, Calif.
Branson Instrument, Inc. & Branson Ultrasonic Corp., 37 Brown House Rd., Stamford, Conn.
British Industries Corp., 80 Shore Rd., Port Washington, N. Y.
Brooks Rotameter Co., Lansdale, Pa.
H. J. Burke Co., 49 Washington Ave., Little Ferry, N. J.
Chambersburg Engineering Co., Chambersburg, Pa.
Colsen Corp., The, Somerville, Mass.
Computer Measurements Corp., 5525 Vineland Ave., No. Hollywood, Calif.
Consolidated Avionics Corp., Westbury, N. Y.
Cubic Corp., 5575 Kearny Villa Rd., San Diego, Calif.
Davenport Mfg. Co., 1713 N. Ashland Ave., Chicago 22, Ill.
Daystrom, Inc., 3030 Nebraska Ave., Santa Monica, Calif.
Daystrom Instruments, Archbald, Pa.
Diamond Tool Research Co., 380 Second Ave., New York 10, N. Y.
William Dixon, Inc., 32-42 E. Kinney St., Newark 1, N. J.
Engineering Div., Commercial Casting Co., 8855 Santa Monica Blvd., Los Angeles 46, Calif.
Epic, Inc., 154 Nassau St., New York 38, N. Y.
Erikson Specialized Tool Co., P. O. Box 424, Pico, Calif.
Ferroscope Co., The, 5390 Alhambra Ave., Los Angeles 32, Calif.
Gardner-Denver Co., Keller Tool Div., 580 Eddy St., Providence 3, R. I.
Gruen Electronic Products Div., Gruen Industries, Inc., 630 5th Ave., New York, N. Y.
Heald Machine Co., The, Worcester 6, Mass.
Hunter Spring Co., Lansdale, Pa.
Industrial Washing Machine Corp., 32 Main St., Matawan, N. J.
Irwin Laboratories, 1238 S. Gerhart Ave., Los Angeles 22, Calif.
Janco Corp., 3111 Winona Ave., Burbank, Calif.
Janke & Co., Inc., 38-44 Railroad Ave., Hackensack, N. J.
Keuffel & Esser Co., Hoboken, N. J.
Kingsley Stamping Machine Co., 850 Cahuenga Blvd., Hollywood 38, Calif.
Kistler Instrument Corp., 15 Webster St., N. Tonawanda, N. Y.
Lampkin Laboratories, Inc., Bradenton, Fla.
Land-Air, Inc., 7444 Wilson Ave., Chicago 31, Ill.
Leiman Bros., Inc., 141-181 Christie St., Newark 5, N. J.
Magnaflux Corp., 7300 W. Lawrence Ave., Chicago 31, Ill.
Mantec, Inc., 126 Maryland St., El Segundo, Calif.
Moran Instrument Corp., 170 E. Orange Grove Ave., Pasadena, Calif.
Multi-Amp Corp., 465 Lehigh Ave., Union, N. J.
Nankervis Co., 15300 Fullerton Ave., Detroit 27, Mich.
Pacific Specialty Manufacturing Co., 700 S. Palm Ave., Alhambra, Calif.
Parker Appliance Co., The, 17325 Euclid Ave., Cleveland 12, Ohio.
Perkins Machine & Gear Co., West Springfield, Mass.
Peschel Elecrtonics, Inc., 13 Garden St., New Rochelle, N. Y.
Radex Corp., 2076 Elston Ave., Chicago, Ill.
Regent Jack Mfg. Co., 11905 Regentview Ave., Downey, Calif.
Research, Inc., 116 N. Buchanan, Hopkins, Minn.
Robins Industries Corp., 214-26 41st Ave., Bayside 61, N. Y.
Schwartz Chemical Co., Inc., 328 West 70th St., New York, N. Y.
Seco Mfg. Co., 5015 Penn Ave., S., Minneapolis 19, Minn.
Bernard Sirotta Co., 624 Smith St., Brooklyn 31, N. Y.
Speedex Mfg. Co., Rockford, Ill.
Sperry Gyroscope Co., Div. Sperry-Rand Corp., Great Neck, L. I., N. Y.
Systems Development, Inc., 307 Water St., Binghamton, N. Y.
Taft-Pierce Mfg. Co., Woonsocket, R. I.
Tensitron, Inc., Pin Hill, Harvard, Mass.
Torsion Balance Co., The, 35 Monhegan St., Clifton, N. J.
Trio Chemical Works, Inc., 341-347 Scholes St., Brooklyn 6, N. Y.
Triplett & Barton, Inc., 831 N. Lake St., P. O. Box 3128, Burbank, Calif.
E. F. Twomey Co., 728 W. 10th Pl., Los Angeles, Calif.
George Ulanet Co., 413 Market St., Newark 5, N. J.
United Manufacturing Co., 41 Haig St., Hamden 12, Calif.
H. A. Wagner Co., Van Nuys, Calif.
Warren Bros. Roads Co., Manufacturing Div., 32 Porter St., Cambridge 42, Mass.
Weldmatic Div., 380 N. Halstead Ave., Pasadena, Calif.
West Coast Research Corp., 2371½ Westwood Blvd., Los Angeles 64, Calif.
Wilson Equipment Corp., 1086 Madison Ave., Paterson 3, N. J.

the wafers, the isothermal condition lasted for eight minutes.

Quartz offers promise of major materials breakthrough

Thermal-shock resistance, strength, light weight and low cost make it attractive substitute for steel; beryllium, columbium also show promise

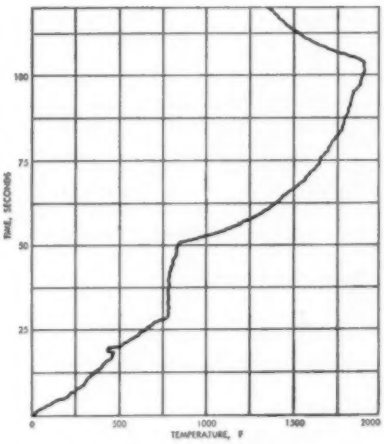
by William Beller

COOKBOOK materials and methods engineers are being thrust out of their laboratories by scientists seeking breakthroughs rather than potpourris for solving problems of high-speed flight. Aviation metallurgists who still call for a pinch of this material plus a sniff of that to be added to boiling steel have become as useless as biplanes. Today, imaginative thinking on a wide scale is being encouraged, and is bringing results. Here are some that may be drafted into service during the next decade.

(1) Quartz, which has good thermal-shock resistance, has been drawn into high tensile-strength fibers, metal-coated and felted into a structural material.

(2) Endothermic (heat-absorbing) materials able to hold back a temperature rise for eight minutes have been developed.

(3) Exotic materials such as beryllium and columbium are showing some structural characteristics vastly superior to those of steel.



TIME-TEMPERATURE CURVE for ammonium iodide impregnated wafer illustrates how an endothermic material can hold back a temperature rise.

Quartz shows strength of steel

Last week, the Bjorksten Research Laboratories, Inc., Madison, Wis., revealed that it had successfully drawn and metalized quartz fibers—some of them to eight miles length. Final fiber thickness was about one-thousand of an inch.

The report put the average tensile strength of these fibers, whether metalized or not, at 211,000 psi, the same as for fully hardened alloy steel. Yet quartz is much more resistant to thermal shock than steel and is only one-third its weight.

The Air Force Office of Scientific Research (Air Research and Development Command) sponsored this work, which has potential applications even wider than glass fibers. Right now, at the request of Wright Air Development Center, Bjorksten Research is sending the agency samples of its material for product application testing.

Compared with most other high-temperature materials, quartz is cheap and readily available. One expected use of the material is for airframe structures. The quartz fibers would first be metal-coated for bonding, perhaps with aluminum, and then felted or matted. The final product would be strong, heat-resistant and stable.

It would also be porous, which property could be turned to strong advantage for transpiration cooling in hypersonic craft. Although present fibers are being coated with aluminum, no trouble is expected when other metals, such as steel or titanium, are used.

The melting point of quartz is about 2,600°F. Therefore the material has interesting possibilities in the electronic field, wherever high-temperature insulations or dielectrics are needed.

Dr. J. Lee Leiserson, who monitored the project for AFOSR, pointed out that this is not the first time that quartz has been drawn so fine. But to his knowledge this is the first time that such high tensiles have been achieved and adherent metal coatings produced.

Heat-absorbing materials possible

Researchers will attempt to burrow through any opening in the thermal thicket, no matter how small, in the hope of finding a clearing further on. For a missile nose cone, this approach calls for studies of materials that will either resist high temperatures or will disintegrate at a reasonable speed.

The Materials Laboratory of the Wright Air Development Center (Air Research and Development Command) is trying to combine the attributes of each of these two types of materials. This study calls for putting solid endothermic (heat-absorbing) additives, which are allowed to melt or sublime, into a porous body, which should remain whole.

The background for this work is seen in two means being developed for high-temperature surface cooling. These are ablation cooling and transpiration cooling. In ablation cooling, heat is absorbed and discarded by removing the liquid phase of a hot surface from its parent solid phase. Phase separation is effected by aerodynamic drag.

For transpiration cooling, a liquid coolant is pumped through hot surfaces and removed mechanically.

Each of these two systems has fundamental drawbacks, which endothermic cooling is attempting to overcome. Ablation cooling results in mass loss plus a radical change in body dimensions. This could lead to aerodynamic instability and loss of control.

Although transpiration cooling leaves the body geometry alone, the system needs large coolant weights, complex pumping systems, surface perforations and gives rise to a nervous center of gravity.

Neither of the systems makes economical use of a coolant's full energy-absorption qualities. Mass removal takes place before the coolant reaches its phase extreme.

In the endothermic system proposed a solid coolant is incorporated in the matrix of an aerodynamic surface material. If the fusion or sublimation temperature of the coolant is less than that of the matrix—which is a necessary condition—the coolant in a liquid or vapor phase removes heat by departing from the matrix.

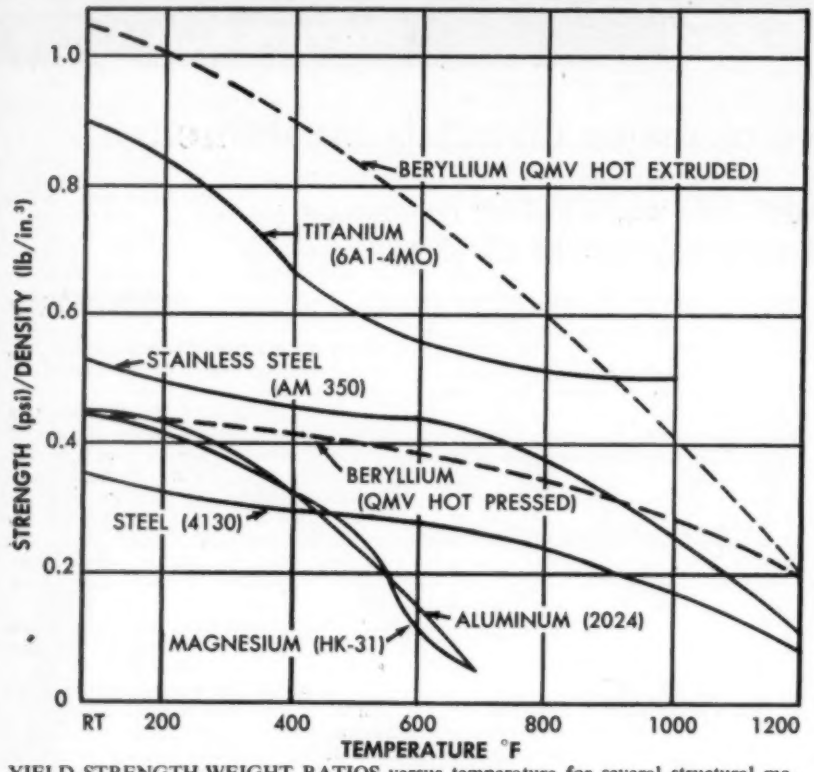
The amount of heat absorbed and them removed per unit mass is equal to the enthalpy change of the coolant as it is transformed from its solid phase to a vapor.

In the first part of this Materials Lab program, graphite wafers were impregnated with various salts and then exposed to a thermal source of 3.3 x 10^5 Btu/sq. ft.-hr. The wafers were 2 inches in diameter and 3/16 inch thick. Density was about 96 lb./cu. ft., which indicates a moderate porosity, enough to allow gases and liquids to pass through the wafers by means of a simple vacuum technique.

Before exposure, the wafers were soaked in saturated solutions of one of several salts for 48 hours and then dried. At the same time, a control

characteristics, WADC has begun work to develop the metal into a usable

NACA lab develops high temperature tensile test apparatus



YIELD STRENGTH-WEIGHT RATIOS versus temperature for several structural materials shows value of beryllium.

wafer was made in order to furnish a datum for the time-temperature curve and also to establish the peak equilibrium temperature.

A typical time-temperature curve for a graphite wafer impregnated with about one gram of an ammonium iodide salt came out as follows: For the first 30 seconds' exposure, the temperature rose sharply in a manner similar to that of the control wafer's time-temperature curve. At about 750°F, the curve for the impregnated wafer broke sharply and continued isothermally for 25 seconds.

During this time, dense clouds of white and violet vapors issued from the graphite body. The origin of these clouds at 750°F is curious, say the investigators, because ammonium iodide is not supposed to sublimate until it reaches 1,022°F.

With the ending of the vaporization phase, the temperature began climbing until equilibrium was reached at about 2,000°F. The shape and profile of the time-temperature curve after the isothermal region was similar to that for the control wafer. The experimenters reported that the isothermal phenomenon was reproducible for other wafers impregnated with the same salt and was of the same order of magnitude with respect to time.

The practical problem for a missile nose cone is to achieve a temperature lag long enough for a missile to pass through its re-entry phase. This criterion led to a second phase WADC study. In this one, a cylindrical graphite body, 1 5/8 in. diameter and 1 1/8 in. long, was used. A one-by-one inch round hole was drilled through the front face, and plugged with ammonium iodide.

Under test, a definite break occured in the time-temperature curve, just as with the wafers. But with the new model, since the amount of salt present was many times that held by the wafers, the isothermal condition lasted for eight minutes.

The next ten minutes, as the salt store was being depleted, the temperature began rising slowly. After ten minutes, the curve rose more sharply, but did not even begin to approach the slope of the control curve. Although neither test was run to final equilibrium condition, it was assumed that eventually the control curve would meet the model test curve.

Nobody claimed that the materials used in these studies were even close to the optimum ones. The results indicated only interesting prospects for future work.

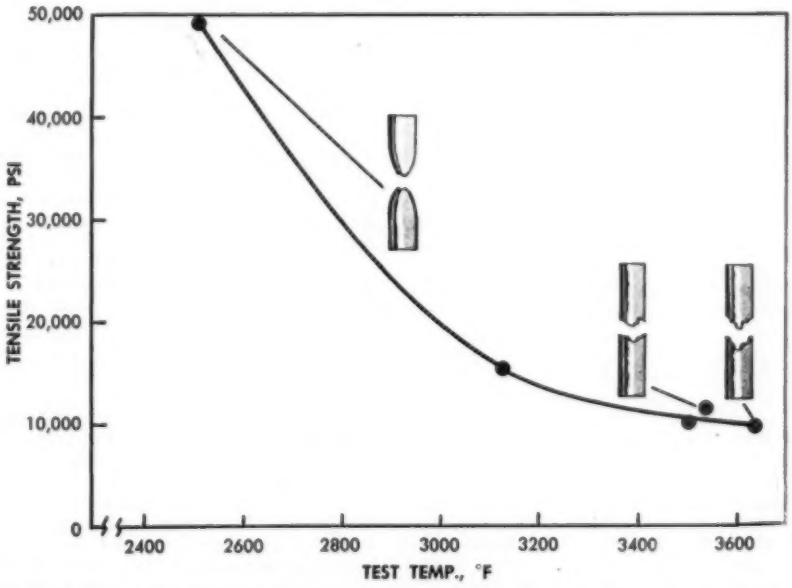
Beryllium halves structural weight

The metal beryllium, because of its ability to slow down neutrons released during fission of an atomic fuel, was brought into sharp focus in 1940 by a University of Chicago researcher. But the metal's use as a structural material is a recent thought. It is one, though, that could bring spectacular improvements in aircraft and missile performance.

Many analyses have shown that beryllium airframe structures would weigh less than half as much as equivalent strength aluminum structures. Similar weight savings are also indicated when the metal is used for high-temperature work.

There is no question in the minds of some experts that beryllium is the best answer to an aircraft designer's prayers. The metal has high strength, is as light as magnesium, has a melting point twice that of aluminum, and is stiffer than stainless steel.

There are drawbacks. Beryllium is brittle, toxic during fabrication, not readily available and costly. To reduce or eliminate some of these undesirable



TENSILE STRENGTHS of tungsten at high temperatures were found by NACA-developed apparatus. Tungsten alloys are being sought.

characteristics, WADC has begun work to develop the metal into a usable material.

Dr. George A. Hoffman, research scientist at the RAND Corp., Santa Monica, reported to the Institute of Aeronautical Sciences that transport aircraft using beryllium would fly 40% further than all-aluminum transports. In addition, beryllium transport aircraft would be far cheaper to operate.

By looking at the economics of present transport aircraft, Hoffman derived the "worth in use" of beryllium. Because a pound of beryllium does the job of two pounds of aluminum, it is equal in value to a pound of payload carried throughout the life of the airplane. Thus, said Hoffman, the worth value of beryllium may be as much as $500 to $1,000 per pound.

Part of the WADC Materials Laboratory program is to study the possibility of alloying beryllium. So far there are no structural alloys of the metal. The goals of this study are (1) to obtain an alloy having physical characteristics superior to those of commercially available beryllium; and (2) to produce a beryllium alloy that can be more readily rolled, extruded and fabricated into aircraft and missile components. Metals such as copper, nickel, cobalt, aluminum, tin and iron are to be examined as possible alloying elements.

Materials Laboratory engineer Lt. J. G. Conner, USAF, tells of other beryllium programs being planned by the Air Force. The Aircraft Laboratory, WADC, is presently concerned with designing, evaluating and flight testing a beryllium missile component.

The Manufacturing Methods Branch of the Air Materiel Command is planning a beryllium sheet-rolling project. Production techniques will be used in the agency's attempt to fabricate 60 x 30 x .020-inch sheets. Out of this work is expected data for Air Force beryllium-sheet specifications.

Here is some beryllium cost information from one of the major producers, the Brush Beryllium Co., Cleveland. At present, the beryllium commercially available is QMV, which is essentially 98+% beryllium with up to 1.5% BeO plus 0.5% impurities. For simple machined shapes in small volumes, the cost of QMV beryllium "is in the area of $100/lb."

The price of the metal has been halved in the last five years, chiefly because of increased production. Brush Beryllium expects this trend to continue.

NACA studies columbium, tungsten

Every high melting point metallic element is deficient in oxidation-resistance. This fact continues to frustrate metallurgists. It also provides them with basic building block materials that possibly could be alloyed or coated to cut down the penalties of erosion.

The Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, is currently grooming two of these elements, tungsten and columbium (niobium), for use in the next five to ten years. Tungsten melts at 6,100°F and columbium at 4,500°F. These elements may be compared with titanium, which melts at about 3,000°F.

Research shows that at temperature above 1,100°F, the oxide formed on columbium is porous and non-protective. Hence, an early goal of NACA is to produce an alloy which under high-temperature oxidation forms a tightly adherent, mechanically sound scale.

If such an alloy cannot be found, then a less ambitious task will be set: to reduce the rate of diffusion of the metal through its oxide scale in order to lower the oxidation rate to an acceptable level.

NACA engineers Charles A. Barrett and Francis J. Clause see good possibilities for columbium, and also a tortuous path in making it an engineering material. These men recently made a survey of the behavior of binary alloys of columbium at temperatures of 1,800°F and 2,200°F. These are their conclusions:

(1) None of the alloys studied so far show sufficient improvement in oxidation-resistance to be useful in the 2,000°F region.

(2) A few of the elements—particularly titanium and chromium and, to a lesser extent, aluminum, iron and cobalt—show enough promise to call for additional work.

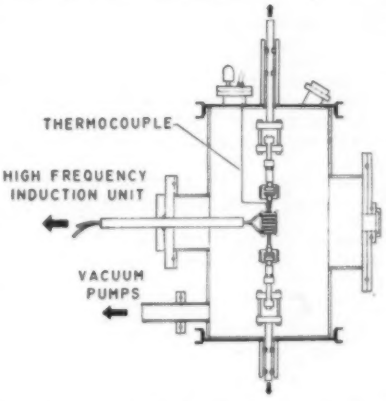
(3) Higher temperatures tend to sinter some oxide scales and make them less porous. This effect can partly offset the normal increase in oxidation rates with temperature.

(4) Many of the scales that were least porous and most dense showed a tendency to spall during cooling.

The NACA program for finding alloys of tungsten has not yet ad-

NACA lab develops high-temperature tensile test apparatus

Equipment for finding tensile strengths of materials in the range from 2,500°F to 3,700°F has been developed at the NACA Lewis Laboratory. Because many of the refractory materials that must be tested are not available in lengths greater than 5 inches, the apparatus was designed around a specimen of this size. Also, because many refractories are electrical insulators, direct resistance heating of the specimen was not considered.



The method of gripping specimens is the limiting factor in many high-temperature tensile tests. Usually, specimen grips that are strong at the evaluation temperatures must be provided. NACA skirted this problem by using a very short furnace through which the ends of the specimens protrude.

Gripping is done at temperatures where conventional high-temperature alloys can be used for grips (1,400°F for a specimen temperature of 3,500° F). The use of specimens having cold ends, however, has one disadvantage. It induces a severe temperature gradient in the specimen and results in a short effective gage length.

The furnace consists of a thin-walled tantalum tube (.020-inch wall thickness) heated by an induction coil. The middle 2 inches of the 5 x ¼-inch gauge-diameter specimen is heated by this tantalum tube. Heat losses are minimized by a molybdenum tube which acts as a radiation shield. This radiation shield is split longitudinally to prevent its acting as a susceptor to the induction field.

Uniaxial loading of the specimen is necessary to avoid premature failure when evaluating such brittle materials as refractories and cermets. In the apparatus developed, the load is applied through two balls, which are accurately positioned in line with the axis of precision-machined loading rods.

The entire apparatus is enclosed in a water-cooled vacuum chamber. Most evaluations are conducted at a pressure of 2 x 10^{-5} mm Hg.

Temperature is measured by a thermocouple spot-welded to the midpoint of the test specimen. For temperatures up to 2,900°F, platinum-platinum 13% rhodium thermocouples are used. Above 2,900°F, molybdenum-tungsten themocouples are used.

In the course of checking out the apparatus, the tensile strength of commercially pure, sintered tungsten was determined at temperatures from 2,500°F to 3,600°F. The tests were conducted at a cross-head speed of 1/16-inch per minute.

Densities & approximate melting points of six metals

Metal	Density (lb./cu. in.)	Melting Pt. (°F)
Beryllium	0.066	2,345
Stainless Steel (AM 350)	0.286	2,575
Steel (4130)	0.283	2,750
Titanium (6A1-4Mo)	0.169	3,000
Aluminum (2024).	0.100	1,180
Magnesium (HK-31)	0.063	1,200

vanced as far as that for columbium. However, the study approach and philosophy are similar.

In the overall picture, NACA and other laboratories are seeking gas turbine materials able to resist 2,000°F, ramjet materials with strength at 3,000°F and nuclear rocket materials that will hold together in a 5,000°F environment. The penultimate quest is for nose-cone materials that will survive re-entry, where the stagnation temperatures could range between 10,000°F and 15,000°F.

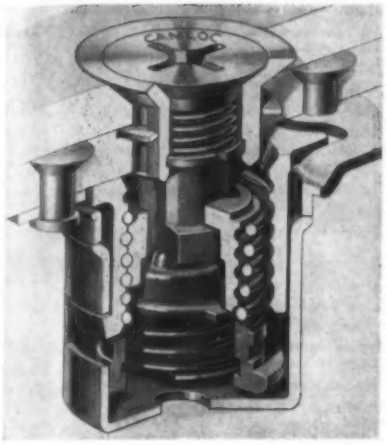
Materials sources & services

Aluminum—Harvey Aluminum Corp., rod, bar, sheet, coil, wire, angles, etc.
Aluminum wire—All-State Welding Alloys Co., Inc.
Anti-static compound—Merix Chemical Co.; for gyroscopes to correct reading on Plexiglas enclosures and on aircraft skin.
Balsa wood—Int'l Balsa Corp.; core material for sandwich construction.
Bearing materials, high temperature—Kennametal Inc.; high-strength, oxidation resistant alloys.
Bearing surfaces—Russell Mfg. Co., require no lubricant; high-temperature pump glands, high strength webs, nose cone materials.
Beryllium—The Brush Beryllium Co.; blocks, rods, bars, sheet, tubing, oxide shapes.
Brass castings—Springfield Brass Co.; also bronze and aluminum castings, jobbing foundry.
Carbon remover—The Penetone Co.; formula 423 for engine overhaul.
Chemicals—Dow Corning Corp.; fluids, resins, rubbers, compounds, emulsions, lubricants, varnishes, specialties.
Chemicals—Hooker Electrochemical Co.; Hetron fire-resistant polyester resin; Fluorolubes jet powerplant lubricants; degreasing compounds, etching compounds, descaling salts.
Chemically-milled metals—United States Chemical Milling Corp.; aluminum magnesium, titanium, steel, flat or formed components up to 50 ft. x 12 ft. x 6 ft.
Chrome—Metal & Thermit Corp.; for plating, dipping; stop lacquers, electrodes for welding machines, protective coatings, other chemicals.
Cleaner, exhaust—The Penetone Co.; formula 831.
Cleaner, exhaust stain—The Penetone Co.; Navee 427.
Cushioning—Armour & Co.; also sandpapers.
Cutting oil—The White & Bagley Co.; for high surface speed work on metals hard to machine.
Dry film lubricant—Drilube Co.; resin-bonded lubricant for high-temperature (1,300 F.) and high loads.
Felt wool—Standard Felt Co.
Finishing, descaling—Turco Products, Inc.; process for finishing and descaling titanium, magnesium, aluminum.
Fluorocarbon products—Shamban Engineering Co.; Teflon, Kel-f, Fluorothene.
Foil—Magnetic Shield Div. Perfection Co.; Co-Neric magnetic foil, Netic magnetic foil for magnetic shielding.
Insulation—Flexonics Corp.; thin wall stainless steel sheathing for non-wicking duct insulation.
Investment castings—Misco Precision Casting Co.; blades, vanes, impellers of high-temperature alloys.
Laminates—Joclin Mfg. Co.; silicone, phenolic, polyester glass-reinforced laminates for aircraft and missiles.
Laminations—Haddon Tool & Mfg. Co.; for rotors and stators.
Low-melting alloys—Cerro de Pasco Sales Corp.; for drop hammer dies, stretch forming blocks, expendable tube bending mandrels, anchoring and shimming, supporting contoured parts during machining, soft metal dies, etc.
Lubricant—Drilube Co.; inorganic lubricant usable in liquid oxygen systems from being impacted.
Lubricant—Lehigh Chemical Co.; Anderol L-825 jet engine lubricant for extreme temperatures.
Mica, glass-bonded—Electronic Mechanics, Inc.—synthetic type in 19" x 29" sheets and moldings for insulation of electrical components.
Mirrors—Semon Bache & Co.; opaque and transparent front surface mirrors, electroplated copper-back mirrors; various glass and lens items.
Nickel alloys—The International Nickel Co., Inc.; Incoloy 901; Inconel 700, 702, 713C.
Plastics—National Vulcanized Fibre Co.; laminated plastics, sheets, rods, tubes, vulcanized fibre.
Plastics—Thomas J. Long, Inc.; laminated plastics, Nylon, Teflon, Plexiglas, acetate, Vinylite, polystyrene, polyethylene, vulcanized fibre.
Polish, aircraft—The Penetone Co.; polish #846.
Polyvinyl chloride—Resinite Dept., The Borden Co., Chemical Div.; manufacture of custom extruded profiles and shapes.
Profile milling—Kaiser Aircraft & Electronics Corp.; profile milling of aircraft structural forgings of aluminum and steel, assembly of airframe parts, fabrication and assembly of missile parts and design and manufacture of electronic testing equipment.
Porous metal products—Poroloy Equipment Corp.
Rare metals—Bram Chemical Co.; manufactures, processes, precision rolls and sell number of metals and alloys, minerals, special chemicals.
Resins—Aries Laboratories, Inc.; casting resins, encapsulating resins, coatings and adhesives.
Rubber coat—The Wilbur & Williams Co.; liquid Hypalon gives adhesion to metal surfaces, has high resistance to ozone at elevated temperatures, available in colors.
Seals, fluorlastic—Joclin Mfg. Co.; ½" to 2" dia.; from 100 to 500°F, 200 to 1000 psig; Vee- or Ell-shape Teflon seal.
Solder—Chemalloy Electronics Corp.; fluxless aluminum type; anti-friction metals.
Spinning—Roland Teiner Co., Inc.; up to 12' dia. on all type metals.
Steel, extruded—Curtiss-Wright Corp., Metals Processing Div.; stainless and alloy in sizes that can be circumscribed by 22" circle; ceramic mold castings.
Stripper, paint & laquer—The Penetone Co.
Tapered skins—Franklin Balmar Corp.; tube-forming, general machining facilities.
Teflon—Ace Gasket Co.; available in tapes, sheets, rods, tubes V-rings, tapered rings, solid rings, other shapes.
Titanium—Mallory Sharon Titanium Corp.; titanium and titanium alloy mill products for aircraft and missiles.
Titanium sponge—U.S. Industrial Chemicals Co. Div. of National Distillers & Chemical Corp.; also trimethyl and triethyl aluminum.
Zinc coating—American Solder & Flux Co.; Drygal for protection of iron and sheet structures.

Directory of manufacturers

For additional information on products listed in this section, write to manufacturers at address below, attention Sales Manager. Give page number and refer to AMERICAN AVIATION ENGINEERS HANDBOOK of new products.

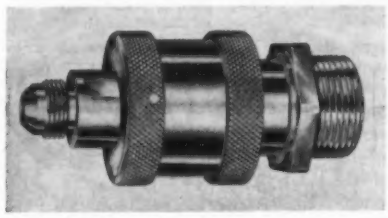
Ace Gasket Co., 1441 Webster Ave., Bronx, N. Y.
All-State Welding Alloys Co., Inc. 249-55 Ferris Ave., White Plains, N. Y.
American Solder & Flux Co., 19th & Willard Sts., Philadelphia 40, Pa.
Aries Laboratories, Inc., 45-33 Davis St., Long Island City 1, N. Y.
Armour & Co., Alliance, Ohio.
Franklin Balmar Corp., Woodberry, Baltimore 11, Md.
Borden, Co., The, Chemical Div., Resinite Dept., P. O. Box 1589, Santa Barbara, Calif.
Bram Chemical Co., Metallurgical Div., 820 6th Ave., Philadelphia 26, Pa.
Brush Beryllium Co., The, 4301 Perkins Ave., Cleveland 3, Ohio
Cerro de Pasco Sales Corp., 300 Park Ave., New York 22, N. Y.
Chemalloy-Electronics Corp., Gillespie Airport, Santee, Calif.
Curtiss-Wright Corp., Metals Processing Div., 760 Northland Ave., Buffalo, N. Y.
Dow Corning Corp., P. O. Box 592, Midland, Mich.
Drilube Co., 723 W. Broadway, Glendale, Calif.
Flexonics Corp., 1352 S. Third Ave., Maywood, Ill.
Haddon Tool & Mfg. Co., Merchantville, N. J.
Harvey Aluminum Corp., 37-32 10th St., Long Island City 1, N. Y.
Hooker Electrochemical Co., Niagara Falls, N. Y.
Int'l Balsa Corp., 98 Boyd Ave., Jersey City 4, N. J.
International Nickel Co., Inc., The, 67 Wall St., New York 5, N. Y.
Investment Casting Co., 60 Brown Ave., Springfield, N. J.
Joclin Mfg. Co., The, Lufbery Ave., Wallingford, Conn.
Kaiser Aircraft & Electronics Corp., P. I. Box 1828, Oakland 4, Calif.
Kennametal, Inc., Latrobe, Pa.
Lehigh Chemical Co., Flatland Rd., Chestertown, Md.
Thomas J. Long, Inc., 215 Stonehinge Lane, Carle Pl., Long Island, N. Y.
Magnetic Shield Div., Perfection Mica Co., 1322 N. Elston Ave., Chicago 22, Ill.
Mallory-Sharon Titanium Corp., Niles, Ohio.
Merix Chemical Co., 1021 E. 55 St., Chicago 15, Ill.
Metal & Thermit Corp., 100 Park Ave., New York 17, N. Y.
Misco Precision Casting Co., 116 W. Gibbs St., Whitehall, Mich.
National Vulcanized Fibre Co., Wilmington 99, Del.
Penetone Co., The, 74 Hudson Ave., Tenafly, N. J.
Poroloy Equipment, Inc., 14943 Califa St., Van Nuys, Calif.
Russell Mfg. Co., The, 400 E. Main St., Middletown, Conn.
Semon Bache & Co., Greenwich & Morton Sts., New York 14, N. Y.
Shamban Engineering Co., 11617 W. Jefferson Blvd., Culver City, Calif.
Springfield Brass Co., 821-27 W. Main St., Springfield 12, Ohio
Standard Felt Co., 29-115 So. Palm Ave., Alhambra, Calif.
Roland Teiner Co., Inc., 134 Tremont St., Everett 49, Mass.
Turco Products, Inc., Terminal Annex 2649, Los Angeles 54, Calif.
U.S. Chemical Milling Corp., 1700 Rosecrans Ave., Manhattan Beach, Calif.
U.S. Industrial Chemicals Co., Div., National Distillers & Chemical Corp., 99 Park Ave., New York 16, N. Y.
White & Bagley Co., The, Worcester, Mass.
Wilbur & Williams Co., The, 130 Lincoln St., Brighton 35, Mass.



GIMBALS
Mfr.: Flexonics Corp.
Model: Type I (shown); Type II
Size: 1.75″ x 2.1″ to 4.03″ x 5.86″
Ratings: Type I 150 psig at 1,000°F. Type II 300 psig at 1,000°F for 1″ through 4″ piping.
Remarks: For aircraft, missile, rocket engine or turbine applications; pneumatic or fluid piping. Angular deflection ± 5°.

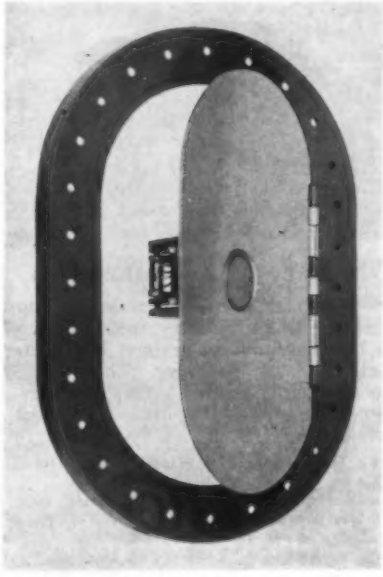
CABINET SLIDE
Mfr.: Chassis-Trak, Inc.
Model: CTL
Size: 14″ x 18″ x 20″
Weight: 2-5 lbs.
Ratings: Supports up to 200 lbs.
Remarks: Facilitates servicing of equipment in electronic cabinets.

METAL BELLOWS
EXTREMELY FLEXIBLE bellows with wall sections as thin as .002″ is available from **The Belfab Corp.** Any weldable material may be used for the units, which are made on automatic machinery. The unit illustrated measures ¾″ o.d. x ¼″ i.d. x ½″ and has a spring rate less than 7 lbs. per in.



HYDRAULIC COUPLING
SELF-SEALING COUPLING is rated for hydraulic systems up to 3,000 psi. Model 3,200 of Aeroquip Corp. is available in sizes from ¼″ to 1½″ dia. Usable at temperatures to 275°F.

STRESSED PANEL FASTENER
Mfr.: Camloc Fastener Corp.
Model: SPF
Size: 1⅛″ x ⅝″ x ⅝″
Weight: .03 lbs.
Ratings: 2,000 lbs. to 4,000 lbs.
Remarks: For stressed skin applications.



ACCESS DOOR
ACCESS DOOR manufactured by Doehler-Jarvis Div. of National Lead Co. is made of aluminum die castings; weight, 5 oz. Opens at fingertip pressure and locks flush with surface in closed position. Dimensions: 5 7/8″ x 3 7/16″.

CLINCH NUTS
MINIATURE, SELF-LOCKING clinch nuts that permit flush installation in stock as thin as .030″ have been developed by Elastic Stop Nut Corp. of America. Nuts are made of cadmium-plated steel and meet applicable requirements of military specifications. Miniature clinch is at left, standard clinch right.

COMBINATION HOSE
Mfr.: Resistoflex Corp.
Sizes: -4 through -24.
Remarks: Jet engine lube line. Flexible section is Resistoflex R-3800 Fluoroflex-T hose, allows for expansion under varying jet engine temperature conditions.

Product sources and services

Anti-extrusion rings—E. F. Houghton & Co.; molded from powdered Teflon with special heat-resistant filling which fortifies Teflon Base.

Bearings—The Fafnir Bearing Co.; new items include swash plate bearing Model Y-396 with i.d. of 26¼″; thin section torque tube bearings Models B-500 and B-500DD; rod end bearings; M-series precision aircraft control bearings.

Bearings—Radial Bearing Corp.; spherical, rod ends, balls with holes and flat sides for use in controls, linkages, self-aligning applications.

Bearings—The Torrington Co.; drawn cup roller bearings, 5/16″ to 1⅛″ shaft dia.

Bolts—The Bland Burner Co.; self indicating "Tru-Load" bolt shows actual preload stress level or load activity on it.

Brush—The Howell Device Co.; nylon machinist chip brush.

Brushes—The Fuller Brush Co.; augmentor tube brush, airplane washing brush, airplane washing mop.

Buckle safety belt—Air Freightways; company also has universal joints, quick release pins.

Cable—Macwhyte Co.; Hi-fatigue aircraft cable, wire rope slings, cable terminals.

Cable—Miljan, Inc.; Teflon Type E for 600 v, type EE 1,000 v, type TB 600 v.

Cables, high temperature—Packard Electric Div., General Motors Corp.; for aircraft and missile systems.

Clips—Atlas E. E. Corp.; transistor clips, locking clips, printed circuit clips, tube holders and shields.

Containers—Scientific Wood Cabinet Co.; all types of cases, cabinets, boxes, trays made of wood.

Containers—Stackbin Corp.; shelves, assembly bins, hoppers, tool cribs, other types of containers.

Couplings—The D.S.D. Mfg. Co.; temperature compensating type from ¾″ to 24″ dia. Also has Toruseal stainless steel

gaskets from ½" o.d. to 60" o.d.

Diaphragms, gaskets—Aero Gasket Corp.; high temperature metal and non-metallic parts, shims, seals, "O"-rings.

Drawers—Snap-On Drawer Co.; individual drawers may be assembled into cabinets.

Drill bushings—R. C. Dudek & Co.; PEM template drill bushings.

Electromagnets—F. W. Shrader Co.; full line of electromagnets and permanent magnets from 2" to 20" dia.

Fasteners—Camloc Fastener Corp.; electronic fasteners, quarter-turn fasteners, hi-temp fasteners, radome latches.

Fasteners—Hi-Shear Rivet Tool Co.; Hi-Shear rivets and Hi-Torque bolts; Hi-Lok fasteners, HL series; blind bolts; blind nuts.

Fasteners—Standard Locknut & Lockwasher, Inc.; bearing retaining locknuts, washers.

Fastenings—Albany Products Co.; stainless steel; for aircraft, missiles, electronic equipment.

Filters—Cuno Engineering Corp.; Poro Klean filters, magnetic, screen types.

Forming pads—Rubbercraft Corp. of Calif.; Hydrop, Dura-Form, Neutra-Form and Uniflo types available for hot, cold soft forming operations.

Gears—Enterprise Tool & Gear Corp.

Hose—Cobra Metal Hose Div. of D. K. Mfg. Co.; liquid oxygen connectors, high pressure hose.

Hose—Flexible Metal Hose Mfg. Co.; metal hose, conduits and assemblies available in sizes from ¼" to 1", stainless steel bellows and ducting assemblies.

Hose—Raybestos-Manhattan, Inc.; inflight refueling hose, Teflon lines, hose.

Hose—Resistoflex Corp.; for high temperature, high pressure applications.

Hose fittings, reusable—Resistoflex Corp.; new Seal-Lock reusable fitting for fluorocarbon hose.

Hoses, fittings—The Weatherhead Co., Aviation Div.; MS Ermeto flareless tube fittings, aircraft hose, hose ends, hydraulic and pneumatic cylinders, swivel fittings, valves, drain cocks, forgings, Teflon hose.

Instrument knobs—Gee Lar Mfg. Co.; to military specifications.

Ladders—R. D. Werner Co.; aluminum ladders, scaffolds, stairways, spans, stages.

Lamps—Hertvy Co.; kerosene-fueled blinking lamp.

Lamps—Radiant Lamp Corp.; 400 watt R60 and 700 watt R80 reflector mercury vapor lamps for hangar and apron use.

Lights—Glar-Ban Corp.; Universal "boltlite" 5408 series.

Lights, emergency—Lightalarms, Inc.; lights and lanterns Models TW802 and GH500 for use in hangars.

Mountings—Lord Mfg. Co.; bonded rubber, heavy duty Temproof types.

Nameplates—American Emblem Co.; embossed in brass, aluminum, steel.

Nuts—Westfield Metal Products Co.; titanium, stainless steel.

Packaging—Bekins Industrial Packaging; containers, crating fixtures.

Pins, shear load—Waldick Engineering Co., We-Pins, quick-release type, for aircraft, missiles, ground handling.

Plugs, caps, vents—Technical Development Co.; self-closing magnetic drain plugs, snap-type filler caps, breather vents for gear cases, gear case accessories.

Signs—Ampower Corp.; metal photo plates made to customer specifications for name-plates, signs, placards, circuit diagrams.

Signs—Ervale Corp.; porcelain enamel signs for flight identification, ramp instructions.

Slides—Grant Pulley & Hardware; aluminum ball bearing slides for battery carriers, cockpit window slides.

Sling nets—Eastern Rotorcraft Corp.; helicopter sling nets, cable nets, tie-down fixtures.

Spark plug elbows—Electrical & Mechanical Design Co.; shielded type and special elbows for high altitude, all-weather uses.

Steel tubing—Michigan Seamless Tube Co.; cold-drawn seamless steel tubing.

Tape—Topflight Corp.; polyester film tape and Hi-temp tape. Both are pressure sensitive.

Terminal lugs—H. B. Sherman Mfg. Co.; complete range of sizes; also pneumatic and hand crimping tools.

Tiedown fittings—General Logistics, Sub. of Aeroquip Corp.; 12-jaw stud attachment fitting, 5,000 lb.-tiedown ratchet, 5,000 lb.-tiedown can.

Tubing—Flexonics Corp., standard and high-strength types.

Tubing, thin wall—Western Pneumatic Tube Co.

Valve—Fluidal Valves, Inc.; 1" piston valve controller Model 2-7581, measures 10" x 2⅝" x 3-3/8", weighs 15 lbs., rated at 3,000 psi.

Webbing—The Astrup Co.; all types webbing, buckles, fasteners, snaps, grommets and grommet tools.

Directory of manufacturers

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Aero Gasket Corp., 763 Hanover Rd., Meriden, Conn.
Aeroquip Corp., 300 S. East Ave., Jackson, Mich.
Air Freightways, N. Philadelphia Airport, Philadelphia 36, Pa.
Albany Products Co., Inc., Connecticut Ave., S. Norwalk, Conn.
American Emblem Co., Inc., P.O. Box 116, Utica 1, N. Y.
Astrup Co., The, 2937 W. 25th St., Cleveland 9, Ohio
Ampower Corp., 50 Broad St., New York 4, N. Y.
Atlas E. E. Corp., 47 Prospect St., Woburn, Mass.
Bekins Industrial Packaging Div., Bekins Van & Storage Co., 12512 Inglewood Ave., Hawthorne, Calif.
Belfab Corp., The, 11 Ramah Circle, Agawam, Mass.
Bland Burner Co., The, Precision Threaded Products Div., 83 Woodbine St., Hartford, Conn.
Camloc Fastener Corp., 22 Spring Valley Rd., Paramus, N. J.
Chassis-Trak, Inc., 525 S. Webster Ave., Indianapolis, Ind.
Cobra Metal Hose, 4440 W. 54th St., Chicago 32, Ill.
Cuno Engineering Corp., S. Vine St., Meriden, Conn.
D. K. Manufacturing Co., 5059 S. Kedzie Ave., Chicago 32, Ill.
D. S. D. Manufacturing Co., 3964 Whitney Ave., Hamden, Conn.
Doehler-Jarvis Div., National Lead Co., Toledo 1, Ohio
R. C. Dudek & Co., 407 N. Maple Drive, Beverly Hills, Calif.
Eastern Rotorcraft Corp., P.O. Box 110, Doylestown, Pa.
Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J.
Electrical & Mechanical Design Co., P. O. Box 706, Clark, N. J.
Electronic Mechanics, Inc., 101 Clifton Rd., Clifton, N. J.
Enterprise Tool & Gear Corp., 8320 E. McNichols, Detroit, Mich.
Ervale Corp., 4000 W. Ridge Rd., Presque Isle Station, Erie, Pa.
Fafnir Bearing Co., The, Booth St., New Britain, Conn.
Flexible Metal Hose Mfg. Co., 777 W. 16th St., Costa Mesa, Calif.
Flexonics Corp., Aircraft Div., S. Third Ave., Maywood, Ill.
Fluidal Valves, Inc., P.O. Box 7068, Long Beach 7, Calif.
Fuller Brush Co., The, Fuller Park, Hartford 15, Conn.
Gee-Lar Manufacturing Co., 400 Wyman St., Rockford, Ill.
General Logistics, Subsidiary of Aeroquip Corp., P.O. Box 1071-M, Pasadena, Calif.
Glar-Ban Corp., 607 Seneca Creek Rd., W. Seneca, N. Y.
Grant Pulley & Hardware Corp., High St., W. Nyack, N. Y.
Hertvy Co., Inc., Rego Park 74, New York, N. Y.
Hi-Shear Rivet Tool Co., 2600 W. 246th St., Torrance, Calif.
E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.
Howell Device Co., The, 1083 Erie Cliff, Cleveland 7, Ohio
Joclin Mfg. Co., Lufbury Ave., Wallingford, Conn.
Lightalarms, Inc., 95 Atlantic Ave., Brooklyn 1, N. Y.
Lord Manufacturing Co., 1635 W. 12th St., Erie, Pa.
Macwhyte Co., 2906 14th Ave., Kenosha, Wis.
Michigan Seamless Tube Co., S. Lyon, Mich.
Miljan Inc., 15506 Lakewood Blvd., Paramount, Calif.
Packard Electric Div., General Motors Corp., Warren, Ohio
Radial Bearing Corp., Taylor St., Danbury, Conn.
Radiant Lamp Corp., 300 Jaliff Ave., Newark 8, N. J.
Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J.
Resistoflex Corp., Woodland Rd., Roseland, N. J.
Rubbercraft Corp. of Calif., 1800 W. 220th St., Torrance, Calif.
Scientific Wood Cabinet Co., 83 Holmes St., Belleville, N. J.
H. B. Sherman Mfg. Co., 22 Barney St., Battle Creek, Mich.
F. W. Shrader Co., 11623 S. Broadway, Los Angeles 61, Calif.
Snap-On Drawer Co., Morrow, Ohio
Stackbin Corp., 1079 Main St., Pawtucket, R. I.
Standard Locknut & Lockwasher, Inc., 2256 Valley Ave., Indianapolis 18, Ind.
Technical Development Co., 305 S. Chester Pike, Glenolden, Pa.
Topflight Corp., 9th Ave. & Queen St., York, Pa.
Torrington Co., The, Field St., Torrington, Conn.
Waldick Engineering Co., P.O. Box 221, Garden City, N. Y.
Weatherhead Co., The, Aviation Div., 300 E. 131st St., Cleveland 8, Ohio
R. D. Werner Co., Inc., Greenville, Pa.
Western Pneumatic Tube Co., P.O. Box 487, Kirkland, Wash.
Westfield Metal Products Co., Inc., 1050 Union St., Westfield, Mass.

Roundup of British aircraft accessories industry

by James Hay Stevens

LONDON—There are about 400 suppliers of accessories and ancillary equipment for the British Aircraft Industry, so it is manifestly impossible to record each and every company. However, some 300 of them exhibited at this year's SBAC display and from these the writer has selected the most interesting and enterprising, as revealed by their exhibits and as seen during one man's Farnborough.

Most accessory suppliers are general industrial manufacturers of a particular class of product (e.g. radio, oxygen, metal sheet) with aircraft components as a relatively small part of their output. The purely aeronautical companies, on the other hand, often make an extraordinarily wide variety of products (e.g. testbed silencing *and* shock-absorbing mounting feet), so that they are difficult to classify without being repetitive.

If, for example, one were to choose the heading "propellers": one company also makes engine accessory gearboxes, auxiliary ram-air power packs; another makes missiles, radar gear, turbo-alternators; while a third supplies building material. The only solution, it seems, is to take companies in alphabetical order—compromising, where necessary, in the case of groups and associates. An identifying town has been added to give an idea of distribution in the UK industrial areas.

Accles & Pollock Ltd., Birmingham, a company with an unexcelled reputation for tube manufacture now has a standard range for aircraft work of precision drawn tubes in titanium, tantalum, vanadium, etc. The company also makes numerous tapered seamless components, including rocket-nozzle/reaction-chamber units.

Aero Research Ltd., Duxford, maker of Redux bonding and honeycomb—widely used in the Fokker Friendship—and also the Hidux high-temperature (supersonic) bond demonstrated at the Paris Salon, concentrated at Farnborough upon its Araldite epoxy resin and its uses. Applications of this tough wear-resistant resin are as a glasscloth filler for aircraft components, molded free-flight spinning models and to an incredible number of jig and tool jobs where its low shrinking rate and stability are invaluable—it can even be used, mixed with sand to give bulk, for drophammer dies. A recent application, with glass fiber, is the cooling-air cuff on the D.H. propellers for the tropicalized Alvis Leonides in the Scottish Aviation Twin Pioneer.

Air Trainers Link Ltd., Aylesbury, is currently supplying a Vickers Viscount 802 electronic flight simulator for BEA and has been producing Hunter 4 and 6 simulators for the RAF and Viscount 701 and Elizabethan simulators for BEA. The AT 100/500 General Purpose Trainer, with side-by-side seating, multi-engine "performance" and extensive airline radio aids is in worldwide use. There also are electro-mechanical trainers for the Viscount and Bristol Britannia which incorporate motion in pitch and roll.

Automotive Products Ltd., Leamington Spa, well-known in the automobile industry, is one of the leading gear and hydraulic component suppliers using the trade name Lockheed—no connection with Burbank. The Lockheed Mk. 9 pump on the Viscount now has an overhaul life of 6,000 hours, claimed as a world high. The Mk. 8 pump on the Comet 4 is proposed for a life of 5,000 hours; the accumulators and selectors 10,000 hours; jacks 5,000 hours, and Servodyne power controls 2,500 hours. A Purolator filter (born of recent airline experience) for bulk fuel capable of separating all water, and solids down to 5 microns, is a new development.

Baxter, Woodhouse & Taylor Ltd., Stockport, is a major producer of pressure helmets for the RAF; the latest model incorporates an auto-closing visor, an internal face-molded oxygen mask, low-restriction breathing valve and a quick-release mouth door.

Birfield Industries Ltd., owner of The Phosphor Bronze Co. Ltd., Birmingham, specializes in the flow-control of water, light oils and air; markets Birflo, Multi-Constaflo, Flometric, Flomax, Truflo interlock, Straitflo strainer and the small-capacity Flomite valve standard components.

Blackburn and General Aircraft Ltd., Brough, has gone into production with its license-built Turbomeca Palouste for Royal Navy LP-air starter trucks and has also made a slick tricycle pod weighing less than half a ton for air transportation on standard RAF bomb racks.

R. A. Brand & Co. Ltd., Letchworth, is a specialist in cocooning. The Texikoon zip-fastened cover, the zip is incorporated during initial spray packaging and is re-sealed after every opening, is a great economy for such items as the transport and storage cover for the Blackburn and General Beverley's steel-bladed D.H. propellers.

KELVIN & HUGHES flight-data system incorporates in four instruments information now displayed by at least 10 instruments on current type systems. At top in this mockup is indicated airspeed and Mach meter; below, from left, are altimeter and vertical speed indicator, attitude indicator and navigational display.

Briggs Motor Bodies Ltd., Southampton, a Ford subsidiary, has a large and growing turbine component department. Among units in production are Rolls-Royce Dart and Avon nozzle-box assemblies, Bristol Olympus major "hot-end" components, Armstrong Siddeley Sapphire annular combustion chambers, Napier Gazelle bifurcated exhaust pipes, B & G A Palouste combustion systems, and many different jetpipe and afterburner assemblies.

The British Aluminum Co. Ltd., London, is a principal supplier of aluminum-alloy plate, sheet, coiled strip and extrusions to the aircraft industry. These are fully specified in the company's WA Data Sheet.

British Manufactured Bearings Co. Ltd., Crawley, is a specialist in miniature bearings for missiles, synchromotors, radar instruments, etc. The John Bass Vacuum Cabinet for handling radio-active substances and the assembly of transistors in inert-gas atmospheres—which is complementary to the company's pressure cabinet for

dust-free assembly—is new.

British Messier Ltd., Gloucester, is in full production with the gear and hydraulics for the Bristol Britannia and Sycamore, Hunting Percival Provost, among others. British Messier power controls are licensed to Northrop in the U.S. An interesting missile component is a servo-control system pack about one foot in diameter and more than three feet in length consisting of six HP gas storage bottles, two for the auxiliaries and four for the twin hydraulic accumulators. The latter feed HP fluid to four control-surface actuator valves controlled from the autopilot amplifier through electro-mechanical transducers. Unlike an airplane hydraulic system, the fluid is exhausted to atmosphere; for ground test it is collected in a tank.

The British Oxygen group of companies has a virtual monopoly on this gas in Britain and makes the greater part of the associated equipment. A new automatic control for argonarc spot welding of thin sheet, especially stainless steel, is significant for supersonic airplanes, as also is the tungsten-arc cutting process for aluminum-alloy plate up to 1 in. thick. An automatic arc length control for argonarc welding insures an exceptional degree of weld consistency for parts subject to heat and high pressure, such as rocket motor tubes and turbojet components. A full range of LOX converters and airfield equipment (including 50- and 500-U.S. gals. USAF/NATO trucks) is manufactured. An innovation is the BOAE/LN liquid nitrogen continuous tank-fire protection, weighing only 15 lb./1,200 U.S. gal.

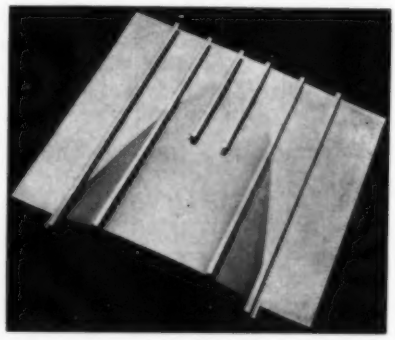
British Refrasil Co. Ltd., Stockton-on-Tees, is a specialist in lightweight temperature insulation and precision pressings in thin-gage metals. The Refrasil heat insulators are American-licensed.

The British Thomson-Houston Co. Ltd., Coventry, is one of the principal producers of starting, ignition and generating equipment in Britain. The single- and multi-shot cartridge and IPN/cordite turbo-starter range available is from 50-500 hp. (BTH claims to have originated the turbo-starter in 1938. The company built the early Whittle centrifugal turbojet for the first British jet airplane, the Gloster E 28/39, which flew in 1941.) BTH also builds military radars and electronic machine-tool controls in addition to a wide range of electrical test devices.

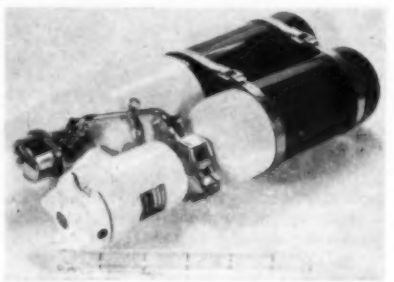
Cementation (Muffelite) Ltd., London, combines the curiously diverse activities of the silencing of engine testbeds (the Olympus turbojet and Thor ramjet beds at Bristol are particularly effective examples) and vibration damping by the air-damped, US-licensed Barrymounts.

The Cossor Group, London, comprises eight British electrical companies, a Canadian subsidiary and an American associate, Beam Instruments Corp. The main aviation product, at the moment, is the mobile (or fixed) CR 21 primary surveillance radar. A very wide range of oscillographs, including the Hydraudyne pressure-testing version for hydraulic and pneumatic systems, is in production.

John Curran Ltd., Cardiff, is a specialist maker of engine testbeds among other equipment. The antenna turning gear for the Cossor Mk VI airfield radar, large centrifuges for the Royal Radar Establishment and the Navy's carrier mirror landing aid are examples of precision structural engineering. The torque-measuring hangar test stand for turboprops, the T Mk 2, is specially designed for measuring the



JETPIPE TRAY assembly for Bristol Britannia fabricated from High Duty Alloys' new heat-resistant aluminum alloy sheet, Hiduminium R.R. 58.



NORMALAIR LTD. passenger oxygen set weighs 3.8 lbs., is 10¾" long, 5" wide and 2½" deep.

rpm/torque/jetpipe temperature relationship for power recording.

Decca Radar and The Decca Navigator Co., London, currently produce the Mark 331A Flight Log, Mark 10 receiver, the long-range Dectra and a range of airfield control, approach, navigational aid, meteorological and airfield surface movement radars.

The de Havilland Engine Co. Ltd., Leavesden, pursuant to its policy of developing the use of HTP has produced 25-hp and 50-hp low-loss, cold (1,100°F) turbine APUs. The 25-hp model weighs 23 lb., is 8 in. in length and diameter. An HTP turbo-starter for the Gyron weighs 46 lb., measures 6 in. in diameter and 15.6 in. long—a particular virtue is that when mounted in a turbojet nose bullet the steam and oxygen exhaust has no ill effect on the engine, so that it need not be ducted overboard.

De Havilland Propellers Ltd., Hatfield, despite Firestreak activities, still has a large production investment in its original Hamilton Standard-licensed product—Beverley, Britannia, Pembroke, Shackleton, Dove, Heron and Scottish Aviation Pioneer and Twin Pioneer are all production models. The 14 ft. 6 in. light-alloy blade propeller for the R-R tynes in the Vickers Vanguard promises further production even in the jetliner era. The weapon division designs all its own components and its turbo-alternator appears to be used on the AWA Seaslug. A new product is the high g-resistant hydraulic scanner mechanism developed for the all-weather radar in the D.H. Sea Vixen.

Delaney Gallay Ltd., Cricklewood, a long established oil cooler and radiator maker is now concentrating as much on thermal insulation as heat exchanging. Already in use subsonically (the Dart exhaust ducts on the Fokker Friendship is one example), its Thermoflex blankets have an assured future as speeds rise: Type P (dimpled stainless-steel foil with refractory fiber packing and weighing 0.65 lb./sq.ft.) offers 50% temperature gradient up to 1,830°F; while Type K (wrapper, outer foil only grooved, weight 0.47 lb./sq.ft.) gives good protection up to 930°F.

The Dowty Group, Cheltenham, famed for landing gear and hydraulics, now has a fuel system and a sealing subsidiary, as well as a Canadian company. A single-circuit spillburner supersonic turbojet control system has been developed for the D.H. Gyron Jr. Among the very wide range of current products are the Fokker Friendship main leg, the Avro Vulcan bogie, liquid-spring shock-absorbers on the Lockheed Starfighter, the Vardel 4,000 lb./sq. in. hydraulic pump and an airplane power-control valve incorporating autostabilization. A torque-motor servo valve has been developed for missile fin actuation; other known missile units are a fixed-displacement pump operating at 8,000 rpm and 3,000 lb./sq. in. and a miniaturized high-speed pump weighing only 12.8 oz.

The Dunlop Rubber Co. Ltd., Coventry, in addition to its airplane tires, wheels and Maxaret brakes, makes the Maxivue windshield wiper and a wide range of pneumatic equipment, including g-suit controls. Dunlop now makes a hydraulic brake system for high-performance airplanes to supplement the familiar pneumatic system, so long a characteristic feature of British service and civil airplanes. Dunlop makes the disk brake for the Rotol gearbox shaft drive that stops the propellers of the portside Darts on Viscounts with front cabin-door Airstairs. A new device is a pressure-impulse counter for determining fatigue life of pressure vessels.

E. K. Cole Ltd. and Ekco Electronics, Southend-on-Sea, is one of the largest radio organizations in Britain. The electronics company now offers three variants of search (cloud-and-collision warning) radar, the E.120 X-band for Britannias, E.160 X-band for Comet, Boeing 707 and Vanguard, and

a C-band model—the latter a prototype. The company also makes a 3-cm radar one-man airfield approach aid and electronic machine-tool controls.

Electro-Hydraulics Ltd., Warrington, is another of the main gear and hydraulic manufacturers—the Handley Page Herald gear and hydraulics are current items. Missile details are also made. A working model of the "quadricycle" landing gear for thin-winged supersonic airplanes was shown at Farnborough. Apart from the model's close resemblance to an Avro supersonic airliner project, the scheme itself is interesting. The gear consists of a main bogie near the cg, a nosewheel and lateral balancing wheels. It is claimed to offer a light, easily stowed gear, without the sensitivity to attitude of the "bicycle" type. A similar system has been suggested for one of the Handley Page laminarized VLR airliner projects (the companies have a long association).

Elliot Equipment Ltd., Slough, (whose material is marketed by Cory Brothers of London and Cardiff) is a major supplier of inflatable life-rafts, dinghies and jackets. New developments are the inflatable escape chute for the Beverley tail-boom cabin, 20 ft. above ground, and a 20-oz. lightweight lifejacket with a rescue handgrip.

Elliott Bros. (London) Ltd. has a tie-up with Bendix and is an electronics concern with wide ramifications. Tops in current interest are its air data computer, missile homing head, and a new fuel flowmeter developed for the Viscount. The air data computer is the centralized source of aerodynamic data (pressure, temperature, free airstream) upon which the Smiths Air Data System for supersonic fighters is based. The flowmeter consists of a variable-area orifice metering chamber, a transmitter, amplifier and an indicator unit showing rate by a needle, and "fuel-gone" by a digital counter.

The Fairey Aviation Co. Ltd., Hayes, has many subsidiaries and associates with activities ranging from air survey to "lost-wax" high-strength steel casting. Much of this work has arisen from "do it yourself" activities in making specialized components for Fairey naval airplanes, the supersonic F.D.2, helicopters and missiles. In addition to the Fairey power controls (Hydroboosters) that are in wide service at home and abroad, there are undercarriages, jacks, the pressure-line Microfilter, specialized vibration analyzers and isolators (by Fairey Air Surveys, while investment casting in 65 and 80 ton steels, catapult launching hooks are an example, have a profile accuracy of ±0.010 in., with 80-130 microinch finish after blast cleaning. Then, too, there is the Fairey envelope jigging, used extensively on the Gnat, Vulcan and Nord 2500.

Ferranti Ltd., Manchester and Edinburgh, already famous for its flight instruments, gun and missile sights and many electronic devices, including the Pegasus data-processing computer, is now in the forefront of missile development as the designer of the entire guidance and control of the Bloodhound Weapon System.

Fibreglass Ltd., St. Helens, supplies all forms of glass fiber for use structurally and electrically.

Fireproof Tanks Ltd., Portsmouth, not only makes self-sealing fuel tanks; but also a plastic-film "incompatible" liner for HTP tanks to prevent decomposition; lightweight flexible Hycatrol tanks, recuperator bladder and diaphragm tanks, and insecticide tanks.

Firth-Vickers Stainless Steels Ltd., Sheffield, claims to be the largest producer in Europe and specializes in aeronautical applications of "Staybrite."

Flight Refuelling Ltd., Tarrant Rushton, which has a U.S. associate Flight Refueling Inc., not only invented the probe-and-drogue system, but is Britain's principal supplier of aircraft fueling equipment. FR valves, pressure connections, vents, etc., are virtually universal on British airplanes —and are also fitted by Breguet, Dassault and Sud-Aviation to their latest products, including the Caravelle.

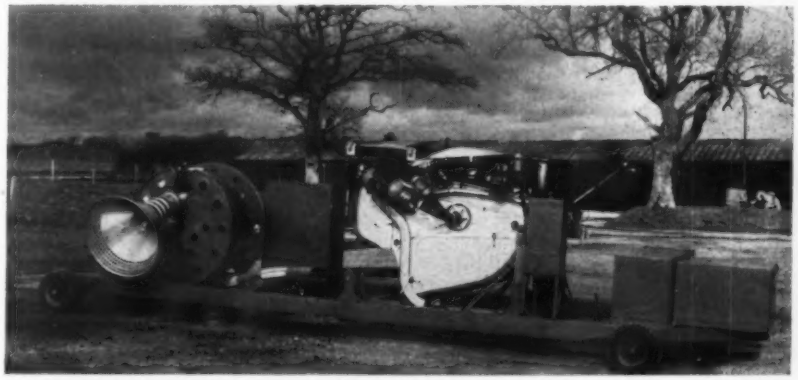
P. Frankenstein & Sons, Manchester, is a major supplier of inflatable survival equipment. At Farnborough a suicidal-seeming dummy was shown in a Mk. 1 pressure jerkin and Mk. 4 anti-g suit, together with Mae West and Type Z dinghy. A new "underarm flotation" lifejacket allows better access to the pressure helmet. A baby's floating survival cot has been developed for airline use. Many airlines, including BEA and BOAC, use Frankenstein lifejackets.

The General Electric Co. Ltd., London, which has no connection with the U.S. GE, is involved in missile work (the AWA Seaslug has been officially mentioned) and showed at Farnborough a film of an AAM which looked much like the Vickers 888. The company, in addition to making varied aircraft electrical gear, is *the* British specialist in catering equipment (40 airlines supplied) and cabin lighting.

Sir George Godfrey and Partners Ltd., Hanworth, now has Australian and Canadian associate companies, and is a leading supplier of airline and military pressurization and air-conditioning equipment—it is now also in the missile field with turbo-alternators, and among the turbojets with a pneumatic afterburner actuator.

The G.Q. Parachute Co. Ltd., Woking, makes air-ventilated clothing and a pressure helmet as well as parachutes and safety harness.

Gloster Aircraft Ltd., Gloucester, with the end of the Javelin within sight, has established a Technical Development Division that has already devised HTP control valves for a new missile, an auto-pitch stabilizer (for airplanes or missiles) and cabin air-conditioning for the Scottish Aviation Twin Pioneer.



HIGH RATE of flow Mk. 16 Flight Refuelling Ltd. hose drum package unit for RAF is shown here on handling trolley, which also contains all necessary servicing tools and test panels. Hose unit is part of main refueling package.

The Graviner Manufacturing Co. Ltd., Colnbrook, is well known for fire and explosion protection devices and equipment.

The Hairlok Co. Ltd., Bedford, is famed for rubberized hair and Telfoam latex upholstery. The company makes Hairlok-lined transport cases for the D.H. Firestreak, which is divided into front and rear units with the wings and fins removed.

Heenan and Froude Ltd., Worcester, is a name synonymous with dynamometers in Great Britain. A new device is a small I.E. hydraulic dynamometer for testing auxiliaries and power takeoffs. H & F is currently installing torque-reaction test stands for Air India at Bombay, a Dart stand for KLM at Schiphol and stands for BEA and BOAC at LAP—the latter for the Proteus but with an ultimate capacity of 10,000 hp.

High Duty Alloys Ltd., Slough, is a member of the vast Hawker Siddeley Group, and was established prior to WW II to provide high-grade light-alloy castings, forgings and stampings for the aircraft industry as it was being expanded for re-armament. Forgings are made in most metals, including titanium, stainless steel and the Nimonic nickel alloys, as well as the company's own well-known Hiduminium (aluminum) and Magnuminium (magnesium) alloys. A significant new development is R.R.58 sheet for skinning

supersonic airplanes—R.R. 58 is a long-established piston and cylinder-head alloy which can be used at 480°F.

H. M. Hobson Ltd., Wolverhampton, makes power flying controls, many varieties of actuator, fuel-control components and the feel simulators fitted to the Britannia, Caravelle and Victor. Ramjet fuel controls (a simple unit is made for the RB-108), missile actuators and the Hobson 214 hydraulic actuator (for use with the Elliott airplane autostabilizer) are new products.

Hunting Percival Aircraft Ltd., Luton, is primarily the airplane manufacturing element of a large air transport, shipping and survey group. New developments, however, are in hand. One of these is the Harrier, air-transportable disassemblable four-seat Army field car. Seating four, it weighs 700 lbs., stows in 33 cu. ft. and can carry 560 lbs. of freight with the driver alone and seats folded. The engine is a 650 cc. BSA two-cylinder unit.

A second novelty is the Mhoglas non-metallic heating element, which was developed to provide even heating over a range from a few degrees above ambient up to 400°F at voltages from 2.5 to 240. To achieve the necessary resistance a semi-conductor, pure graphite, was necessary, and this is deposited on a glass fabric base and coated with Araldite epoxy resin, using a sprayed zinc busbar. The Mhoglas mats are flexible and easily wrapped around ducts or other components to be heated.

The Hymatic Engineering Co. Ltd., Redditch, was the major supplier of pneumatic system components when most British airplanes used this form of auxiliary power. Today, the company makes anti-g valves and has recently evolved the PS.93 integrating servo, which can accept air at 750°F and 400 cu. ft./min. and electro-pneumatic valves for 4,000 lb./sq. in.

Imperial Chemical Industries Ltd., London, is the principal British producer of titanium by the sodium-reduction method and markets a large range of alloys as sheet, plate, bar and tube. Very extensively used as a wide temperature range (−110°F to +480° F) low-friction seal, insulator and bearing plastic, is ICI's Fluon—poly-tetra-fluoroethylene.

Irving Air Chute of Great Britain Ltd., Letchworth, is still very much Leslie Irvin's company, the first to supply the RAF with parachutes. Today, automatic parachutes are the thing, plus the EB.50 low-price glider parachute, the new lightweight flying suit and harness and safety belts. Brake chutes are supplied, among others, for the Vulcan, P.1B, to SAAB and to Marcel Dassault, for the Bobbin and Thunderbird missiles.

Jablo Propellers Ltd., Croydon, makes an expanded foamed plastic sandwich for airplane floors, seats, etc.

William Jessop & Sons Ltd., Sheffield, is an old-established alloy steel maker, of which the Vacumelt materials are particularly pure for bearing, compressor and turbine parts. The company markets the Hylite range of titanium stock and also supplies it as forgings and stampings.

King Aircraft Corp. Ltd., Glasgow, has built up a remarkable reputation for quick-release fasteners since the end of WW II and is a vital missile accessory supplier—where rapid g-resistant latching is an operational necessity.

Joseph Lucas, Birmingham, a leading electrical battery supplier, today is the principal supplier of combustion equipment for British gas turbines—there is hardly an engine in which the flame tubes have not been designed in collaboration with the engine maker.

Marconi's Wireless Telegraph Co. Ltd., Chelmsford, has two overseas associates, Canadian Marconi and Amalgamated Wireless (Australasia). As one of the leading, if not *the* leading, British aviation radio/radar suppliers, Marconi covers a wide field. Top in interest today is the range of airborne Doppler Navigators; the AD 2000, which has been in RAF use for three years and the developed AD 2100. For civil use, the lightweight, 130 lb. complete, AD 2300 offers a navigational aid that is accurate from 80-900 kts and 0-50,000 ft. Marconi is making a comprehensive jetliner radio system for the Comet 4—Type AD 712 ADF, Type AD 305 VHF multichannel transmitter, Type AD 704 VHF receiver, Type AD 307 multichannel HF communication equipment, VOR/ILS receiving equipment and the Marconi aircraft selective calling system.

FERRANTI LTD. silicon junction diodes and silicon power rectifiers with rectified output of up to 30 amp. from a single diode.

Martin-Baker Aircraft Co. Ltd., Denham, has supplied all ejector seats for RAF aircraft as well as licensing its designs to the U.S. Navy and to Sud-Aviation. The latest fully-automatic seat, with G.Q. duplex drogue and parachute has an 80 ft./sec. ejection gun.

Microcell Ltd., London, is in production with new sleeper-seats for BOAC's Britannias and has made a prototype glass fiber seat. Other products are radomes and rocket pods.

F. G. Miles Ltd., Shoreham. In addition to designing airplanes and subcontracting components, company designs and makes electric actuators and produces phenolic/asbestos parts, including fuel tanks.

M. L. Aviation Co. Ltd., White Waltham, designs and makes the following extraordinarily wide range of items: pressurized aircrew helmets, an inflatable light airplane, air-conditioning and pressurizing ground trucks, jet engine transporters and trolleys, electrical and mechanical releases, armament and deck handling gear.

Murphy Radio Ltd., Welwyn Garden City, another radio communication and navaid supplier has developed a new patented, flexible potting resin usable from −95°F to +250°F ambient (300°F internal) called Castoflex—a caster oil-urethane resin which is supplied as non-toxic liquid raw materials.

D. Napier & Son Ltd., Acton, pops up in the accessory industry with its Spraymat thermo-electric plastic deicing system, as used on the Britannia and Beverley—and being tried on the Caravelle and Friendship.

Normalair Ltd., Yeovil, an associate of Westland Aircraft, with Canadian and Australian companies, has a full range of air-conditioning, temperature-control and both gaseous and liquid oxygen systems.

The Plessey Co. Ltd., Ilford, is a large group of specialist electrical companies which has gradually extended its scope to include such things as emergency ram-air turbines, seamless flexible hoses and the license for the PTSC 220 low-pressure air starter from Hamilton Standard. The exhibition at Farnborough of a new microwave absorbing material was sensationalized by the popular press as radar absorbing.

The material, at present, is strictly for laboratory use and ground testing, where it is necessary to eliminate echos, and the immediate practical application seems to be to buildings causing troublesome permanent echos in airfield installations, or to masts and funnels of ships—the invisible bomber would seem to be a long way away at this stage. The Type AF.10 material, for use in darkrooms, covers the range 2,500-50,000 Mc/s and the AF.11 has a range from 5,000-50,000 Mc/s—the former is 2.2 in. and the latter 1.5 in. thick, both offering better than 99% absorption.

The M series of materials is designed to be more handy and operates on a different interference principle, i.e. a thin layer of material with a high refractive index and critical loss, backed by a reflector and resonant at the design wavelength. A single material suffices for X-band requirements, while two are needed for the S-band. One example is a loaded rubber sheet bonded to brass gauze and is intended for use as a blanking cap over a radome or scanner when ground testing. Two types quoted are 0.075 in. and 0.15 in. thick and are 98% absorbent at 5% and 12% of design frequency, respectively.

Pye Ltd., Cambridge, has made VHF radio for runway control as well as ground-to-air and has equipped the

RAF with its uni-directional, high-accuracy ILS—also transistorized loudspeakers for the Royal Navy.

Redifon Ltd., London, in addition to supplying public-address systems, makes a range of radio receivers, an easily-maintained radio beacon, and designed and built the Vickers Valiant flight simulator for the RAF.

Rotax Ltd., London, specializes in the design of complete AC and DC electrical systems, as well as making all types of electrical generating and starting equipment.

Rotol Ltd., Gloucester, was established in the '30s by Rolls-Royce and Bristol to develop the Hele-Shaw constant-speed propeller which was being made by Glosters. Today the company, which is closely associated with British Messier, is supplying the propellers for almost all Vickers Viscounts and Fokker Friendships.

The Rotol accessory gearbox is a standard Dart fitting with or without the 'airstair' brake drive shaft. Although, theoretically, this brake cannot act in flight, a fusible-alloy safety release is incorporated to insure that it will release itself as it overheats. The Rotol fuel-flow proportioner, which the writer has experienced in the Jet Provost, works like a charm and is invaluable on high-consumption-rate gas turbines.

Joseph Sankey & Sons Ltd., Bilston, is a noted worker in sheet metal; makes Sapphire and Viper annular combustion chamber components and the fantastic RAE, Westcott, LOX/kerosene "quilted" rocket chamber welded in 18/8 stainless steel.

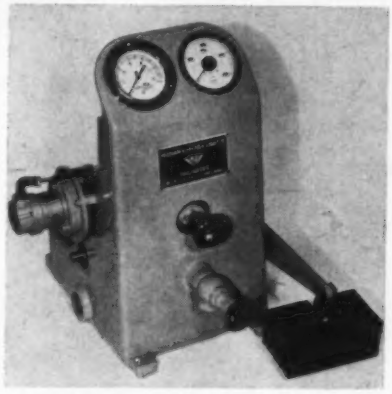
Saunders-Roe Ltd., Isle-of-Wight, actually a large organization with considerable shipping and constructional interest, markets analog computers and desk calculators as well as airplanes. The company has also developed bomb gear and a whole range of ground handling equipment and tankers for HTP.

Short Brothers and Harland Ltd., Belfast, also makes analog computers and has supplied them, among others, to de Havilland Engines, Handley Page, Folland, Supermarine, the RAE, the Netherlands Aeronautical Research Institute, Fiat and Stenhardt Ingeniorsfirma AB, Sweden.

The Smiths Group actually comprises over a dozen companies with wide automobile, marine and timepiece activities. The main aviation interests are: Kelvin & Hughes (Aviation) Ltd., K.L.G. Aviation Products Ltd. (spark plugs and ignition), Smiths Aircraft Instruments Ltd. and Waymouth Gauges and Instruments Ltd.

Kelvin and Hughes is one of the contractors chosen to develop, together with the RAE and the Institute of Aviation Medicine, an entirely new form of military flying instrument presentation called the Flight Data System. The new layout was originated primarily to meet the need to find a means of telling the pilot of a supersonic fighter in a near-vertical climb his attitude, heading and how to roll out on his interception course.

As a secondary factor it was decided to compress all the various instrument pressure, temperature and other information into central dynamic and aerodynamic sources called the Aerodynamic Reference System (pitot, static, temperature computed to IAS, TAS, Mach, height, vertical speed) and Flight Dynamic Reference System (replacing artificial horizon, directional gyro, gyro-magnetic compass, ILS, flight director, Tacan, slip indicator). The photo shows how, in the pilot's display, speed is represented by an automobile-style strip indicator combining IAS and Mach, height and vertical speed by an upright strip (with baro-metric digital counter), centrally is a 360° (roller blind) attitude indicator with a beam director beneath it. On the right is the range and heading information.



HEENAN & FROUDE IE dynamometer suitable for testing such auxiliaries as power takeoffs for generator and pump drives.

Also included with the system is an audio angle-of-attack indicator which is sensitive to aircraft weight. Two further forward-looking instruments exhibited were a percentage rpm indicator (in a 2-in. SAE flangeless case), following the trend to specify turbine engine regimes by percentages of a nominal maximum; and a −1,000 ft. to +50,000 ft. sensitive altimeter with two pointers (10 ft., 100 ft.) and a numbered disk for the 1,000 ft. intervals, plus a low-altitude warning flag which becomes increasingly visible from 10,000 ft. down to zero.

The KLG name is synonymous with ignition in the U.K. and, moving with the times, the company makes a range of high-energy igniters and harness for turbines.

"Smiths" means the Smiths Flight System and the SEP .2 autopilot, a fully-integrated airline flight director system, which the writer has had the privilege of trying for himself. It is an uncannily accurate and simple way of flying the complex modern ATC patterns right down to 200 ft. from the runway threshold. The SFS and SEP .2 are fitted to all new BEA and BOAC airliners.

Waymouth Gauges makes the "Smiths Compensated Fuel Contents Gauge Type I," which is approved for military and civil aircraft. The system is based on the practically proven principle that fuel density is relatable to a di-electric constant—the system operates on 115 volts, 400 c/s.

Waymouth also showed the wide range of Smiths bayonet cable connectors, which are interchangeable with the American BNC standard.

The Sperry Gyroscope Co. Ltd., Brentford, operates as an individual design and manufacturing entity despite its name and close association with the American company. In addition to handling the Zero Reader and the Gyropilot in the U.K., the company has developed an integrated power-control system—which was experimented on a novel electronic-simulator/analogue computer rig. Guided weapon activities include development, in association with GEC and AWA, of the power-control pack for the Seaslug. Sperry also makes hydraulic system components and is the U.K. representative of Vickers Inc.

Teddington Aircraft Controls Ltd., Cefn Coed, is noted for its extensive range of hot-air valves, of both butterfly and carbon-slide type, which can be actuated either electrically or pneumatically. In association, there is a wide range of pressure switches, pneumatic and electrical temperature controls and flexible stainless-steel bellows. Teddington also makes time switches.

T. I. Aluminum Ltd., Birmingham, has evolved a new technique for making its Timinium light-alloy tubes with either external or internal reinforcing butts at each end, so that they may be threaded for connectors without weakening against internal pressure.

Thompson Bros. (Bilston) Ltd., makers of the Prematic pressure control valve, is in the Bloodhound missile program with the welded stainless-steel shell of a Bristol Thor ramjet.

Turner Brothers Asbestos Co. Ltd., Rochdale, is a principal supplier of Durestos resinated felts, flocks and powders for asbestos-reinforced, and Duraglas fiber and Duramat mats for glass-reinforced components.

Ultra Electric Ltd., London, is a commercial radio company which makes the electronic controls for the Bristol Proteus, the SARAH personal radio beacon for the RAF and RN—now used by the Grumman Aircraft.

Henry Wiggin & Co. Ltd., Birmingham, supplies the British aircraft industry with Nimonic alloy stock from the raw materials of The Mond Nickel Co. Ltd. The world-famous Nimonic range of wrought materials has recently been supplemented by the parallel Nimocast series of casting alloys, following the increasing use of pot castings for turbine component flanges. With increasing flight speeds the Nimonic market is manifestly expanding to airframes as well as engines.

Technical reports

Technical literature now available from the Office of Technical Services (OTS), Department of Commerce, Wash. 25, D. C., includes these reports relating to aircraft industry developments.

"Chemical Surface Treatment of Titanium." H. A. Pray, P. D. Miller and R. A. Jeffreys, Battelle Memorial Institute for Army Ordnance Corps. May 1953. 43 pages. $1.25. (Order PB 111805.)

Development of two chemical baths for coating the surfaces of titanium and its alloys for remarkable wear resistance is described.

"Research and Development for the Welding of Titanium and Titanium Alloys." Final Report. J. J. Chyle and I. Kutuchief, A. O. Smith Corp. for Army Ordnance. Apr. 1954. 79 pages. $2. (Order PB 111849.)

Successful welding of titanium alloys containing chromium, iron, manganese, aluminum and molybdenum by the inert-gas shielded tungsten-arc welding process is described in this report.

"Investigation of Forged Cobalt Base Alloys for High Temperature Applications." R. R. MacFarlane, R. K. Pitler, and E. E. Reynolds, Allegheny Ludlum Steel Corp. for WADC. Oct. 1956. 36 pages. $1. (Order PB 121723 from OTS.)

Improvements in the high-temperature properties of a wrought cobalt-base alloy resulted from additions of aluminum, boron, and titanium.

"A Direct Measurement Technique of Determining Rocket Exhaust Velocities." L. E. Bollinger and R. Edse, The Ohio State University Research Foundation for WADC. Nov. 1956. 40 pages. $1. (Order PB 121871 from OTS.)

A six-channel chronograph is described in this final report as a new technique for directly measuring the exhaust velocity of a rocket engine when the jet velocity is near 10,000 ft/sec.

"Performance Standardization for a Turbojet Engine Equipped with a Variable Area Nozzle Controlled by Engine Speed." R. L. O'Neal, USAF Flight Test Center. Mar. 1956. 17 pages. 50 cents. (Order PB 121989 from OTS.)

A method is described for correcting the performance of turbojet engines equipped with a variable geometry exhaust nozzle controlled by a single lever.

"Long-Persistence Three-Color Indicator Cathode-Ray Electron Tube," C. D. Beintema, L. L. Vant-Hull, and S. T. Smith, Hughes Aircraft Co. for WADC. May 1956. 29 pages. 75 cents. (Order PB 121815 from OTS.)

Shadow-mask multicolor storage tubes for radar and other applications with low frame rates have been constructed for the Air Force.

"Investigations of Deformation and Fracture of Metals." R. P. Carreker, Jr., R. W. Guard, and R. E. Lenhart, General Electric Research Laboratory for WADC. May 1955. 25 pages. 75 cents. (Order PB 111838 from OTS.)

This report summarizes the results of investigation into plastic deformation behavior of pure metals as a function of temperature and grain size.

N. Y. Air Brake Co. develops axial-piston hydraulic pump

by William O'Donnell

ENGINEERS at the Watertown Division of New York Air Brake Co. have developed a new aircraft hydraulic pump they say is "best from any angle" when compared with others of comparable size.

The Stratopower 64W1000 overcenter pump is the first step of the company in production of valve-plate pumps with rotating cylinder blocks. Previously, New York Air Brake made only check-valve types.

Senior Project Engineer Ted Budzich says "for the first time, a large capacity hydraulic pump is avialable with a power-to-weight ratio usually associated with small high-speed pumps operating between 8,000 and 10,000 rpm." He points out that a lightweight rotating group enables speeds up to 4,500 rpm continuous duty to be run with the new Stratopower model.

Prototypes of the pump have been tested at the company's laboratories. Weight of the prototypes is 22 lbs. for the 10-gal. pump, but production models are expected to weigh just under 19 lbs. Dimensions are 6¼ in. x 6¼ in. x 9 1/8 in.

The company is designing a 15-gallon pump weighing 24 lbs.

Minimum of hydraulic ripple

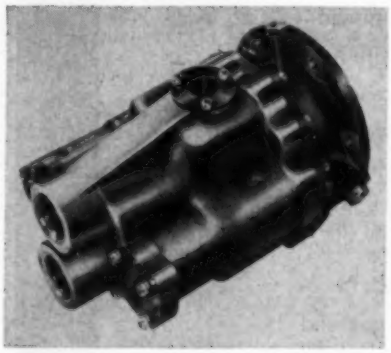
The Stratopower 64W1000 delivers hydraulic fluid at a desired pressure with a minimum of hydraulic ripple. The unit is a nine-cylinder axial-piston pump with a rotating cylinder block and stationary valve plate. The cam is non-rotating but is pivoted to control the axial displacement of the pistons in the cylinder block.

When the cam is displaced to the maximum angle in either direction to the centerline of the drive shaft, the piston stroke is at its maximum. As the cam angle is decreased, the piston stroke and pump output also is decreased until at zero angle the output is zero. As the cam is displaced in the opposite direction, the piston stroke is increased with the fluid flowing in the opposite direction.

As the cylinder block and pistons rotate, fluid entering the intake port is drawn into the cylinder bore during the return stroke of the piston. Continued rotation brings the filled cylinder to the discharge side of the valve (distributor) plate and the piston riding up the cam discharges the fluid through the high-pressure duct.

Power to operate the pump is applied to the rotary cylinder block directly from the shaft.

Budzich points out that the control unit on the pump combines features of rapid response and low differential pressure. At operating speeds, he said, pressure differential between full flow and zero flow is less than 50 psi. This can be lowered to 25 psi, if necessary.



NEW YORK Air Brake Stratopower overcenter pump Model 64W1000.

Some other features

Other features of the new Stratopower pump include:

Low inlet pressurization—at full speed less than 50 psi inlet pressure is required.

Self-aligning rotating members—the rotating group is pivoted about a spherical seat which permits the hydraulic alignment for minimum internal leakages and high volumetric efficiencies.

Low pulsation and oversurge characteristics.

Use as a motor—because of its overcenter configuration, the unit is equally effective as a motor.

High and low pressure ports are not reversed when the cam moves overcenter from pumping to motoring operation or vice versa.

The present design of the pump is for use up to 275°F. With a minimum of modification the 64W1000 will be capable of 400° operation.

Cooling and lubrication is accomplished by leakage in the prototype models, but the production design contains positive circulation of cooling oil. Critical wear points and highly loaded surfaces are hydrostatically balanced by the hydraulic fluid from the high pressure side of the pump. Cooling fluid is returned directly to the reservoir.

New York Air Brake got into the hydraulic business in 1941 when the company purchased Hydraulic Controls, Inc., of Chicago, and eventually moved the facilities to Watertown, N. Y. Hydraulic Controls was engaged in production of steering and brake controls for the M-3 tank built by Chrysler.

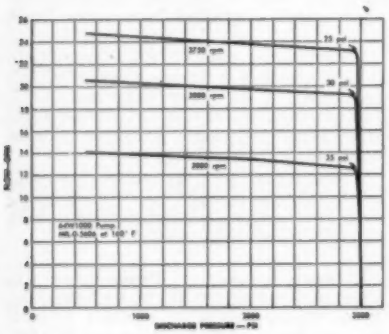
After moving to Watertown the company took on its first aircraft assignment—hydraulic components for the Lockheed P-38 fighter.

NYAB itself was formed in 1890 as an outgrowth of a vacuum brake company. The vacuum brake had been heralded as the best controlling device for rail equipment until trials showed the superiority of the triple-valved air brake. Since that time the Watertown company has been a leader in the production of train brake equipment. In the pre-World War II days the company saw the wisdom of diversification into other fields.

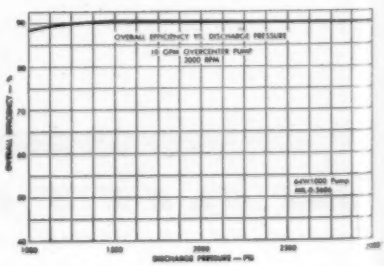
Four other companies acquired

Following the purchase of Hydraulic Controls, the company's position in hydraulic and related fields was strengthened by the purchase of four other companies—Kinney Manufacturing Co., Boston; Hydraulic Equipment Co., Cleveland; Dudco Products Co., Detroit; and Aurora Pump Co., Aurora, Ill. These companies are now operating divisions of New York Air Brake.

Since the initial aircraft work with the P-38, more than half a million Stratopower pumps have been produced for both military and commer-



FLOW IN GPM vs. discharge pressure of New York Air Brake Stratopower overcenter 10 gpm pump using hydraulic fluid MIL-O-5606 at 160°F. Pressure differentials from full 3,000 psi to start of regulating curve are noted at right.



OVERALL EFFICIENCY vs. discharge pressure using hydraulic fluid of MIL-O-5606 of New York Air Brake 10 gpm overcenter Stratopower pump Model 64W100, at 3,000 rpm.

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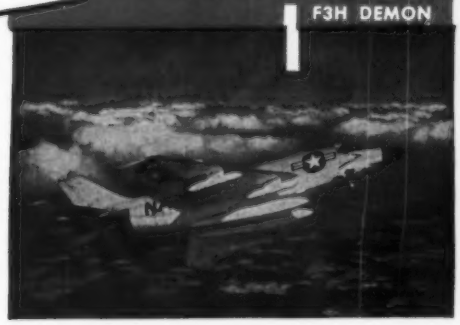

Details on MAC's Operations for Fiscal 1957 Showing

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- **3,284,607 square feet floor space***
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***As of 30 June 1957*

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St. Louis 3, Missouri

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Type assignment in which interested _____

cial aircraft. The pumps were on most military aircraft during World War II. After V-J Day the company entered the commercial aircraft accessory market.

At the present time, a dozen Stratopower pump models are flying the commercial airlines of the world and soon will be appearing on jet airliners.

The Watertown facilities include some 890,000 sq. ft. of covered factory space and the average payroll at Watertown is about 2,000. The plant is fully integrated and all Stratopower parts can be made at the factory with the exception of the rubber O-rings and seals.

At present the company is marketing about 200 different configurations of pumps and motors. These include Series 65W variable delivery pressure compensated type, 65F fixed displacement pump, 67V variable delivery inlet flow regulator, 67MW variable delivery dual pressure servo control, 64F constant displacement, 66W variable delivery pressure compensated type and Series 165, 166, 167, electric motor driven pump.

At Stratopower six project groups are at work on hydraulic accessories for standard operation, high temperature, controls and servo mechanisms, hydraulic motors, electric-driven pumps and high speed pumps and drives.

The company believes that its high temperature hydraulic accessory testting program is probably the most advanced for any firm in the business. Test stands are available in the two ranges—450°F and 700°F for equipment for tomorrow's aircraft; 700°F for equipment being designed for aircraft now in preliminary design stages.

Now under construction is a bunker-type, remotely-controlled stand watched by closed-circuit TV to test equipment under temperatures as high as 1,100°F.

Among the projects in the high temperature field is the development of a pump with a major aircraft manufacturing company.

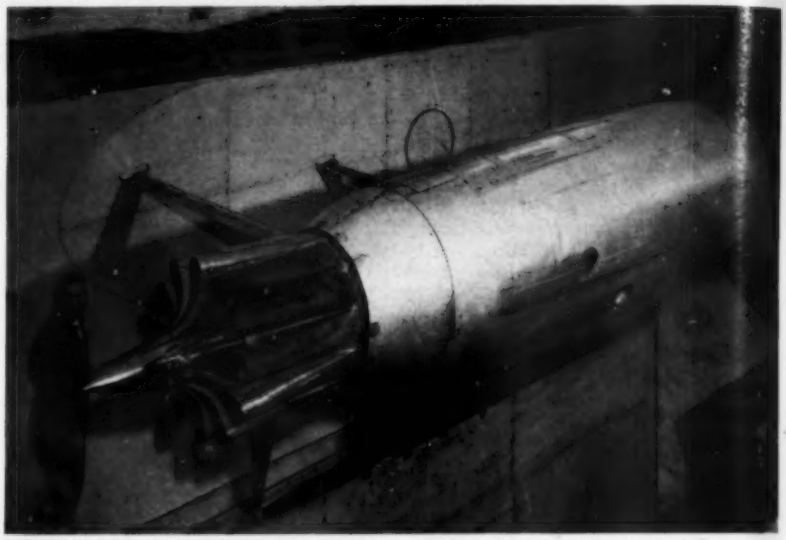
NAA receives contract for hi-temp power system

Air Force has awarded a development contract to North American Aviation, Inc., for an electrical system capable of withstanding the thermal barrier. Work will be done at the Los Angeles Division under Chief Engineer John Maxian, Jr.

The contract covers a four-year program for developing a complete airborne power generating system which can withstand continuing temperatures of 600°F. NAA is responsible for developing and integrating the finished system.

Detail work will be done by subcontractors. Wright Air Development Center's Aeronautical Accessories Laboratory is monitoring the contract.

NACA studies new ways of cutting jet noise



SPECIAL EXHAUST SHAPES developed by NACA attenuate noise level of jet engines. Experimental shape shown brought the 121-decibel level of J47 to 107 decibels.

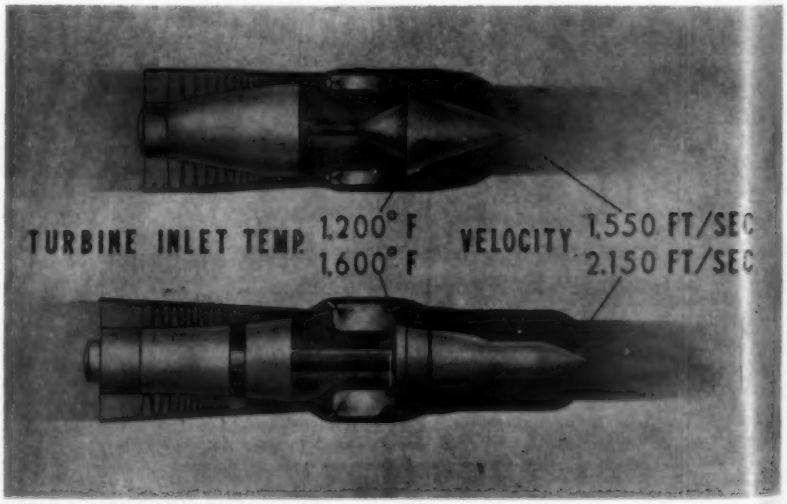
Ways to attenuate jet engine noise are being intensively studied by National Advisory Committee for Aeronautics engineers at the Lewis Flight Propulsion Laboratory in Cleveland.

Originally, it was suspected that the "big" noise of jet engines comes from the combustion of fuels at tremendous rates, and the windage of the whirling compressor blades. It was found, though, that the largest noise component is created by the exhaust jet as it mixes turbulently with the atmosphere. Fluctuating pressure waves are created, which result in a broad band of acoustic waves.

One way to decrease the noise is to lessen turbulent mixing of the jet stream, or the size and strength of the eddies. Various nozzle shapes have been studied which give substantial reductions in the noise level. However, the design changes needed usually bring increased airplane drag, engine weight and decreased engine performance.

Another approach to the problem is to reduce the velocity of the exhaust jet. This would decrease the energy in the jet stream and also the noise level. However, current military jet engines demand high jet velocities for maximum performance. If such performance were not needed, then an economical and efficient engine could be designed with lower exhaust velocities. Such an engine would also operate at lower turbine inlet temperatures and therefore could be made lighter and more compact.

If a special nozzle shape were combined with an engine having a relatively slow-speed jet exhaust, NACA engineers feel that the target 15-decibel drop would be obtained. This 15-decibel figure is based on an average jet noise of 116 decibels as compared with propeller noise of 101 decibels.

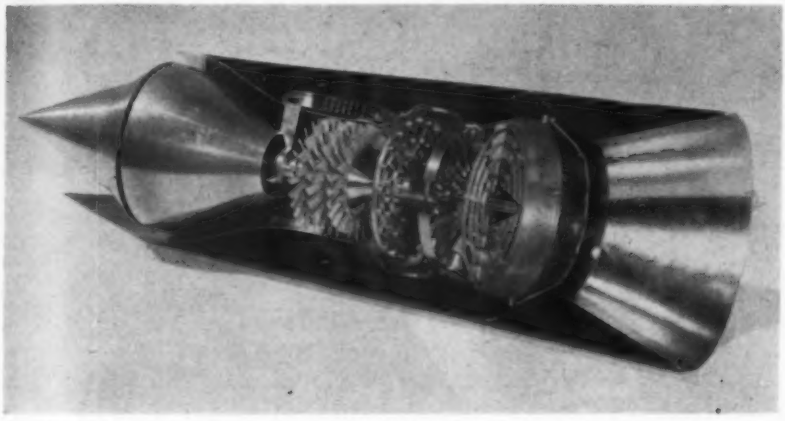


LOWER EXHAUST VELOCITIES can significantly lessen jet noises. Resulting smaller turbine inlet temperature brings about a more compact engine design.

NACA reveals details of Mach 4 turbojet

SUPERSONIC turbojet engines capable of sustaining flight at Mach 4 are within our reach, according to engineers at the Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics. A cutaway view of a model of such an engine, which could power aircraft cruising at 2,600 miles an hour and 85,000 ft. altitude, was displayed at NACA's triennial inspection of the Lewis facilities.

NACA engineers say the Mach 4 turbojet is the ultimate capability for this type engine. But even this capability could not be obtained, they say, unless the engine is equipped with variable inlet and exhaust nozzles. If fixed nozzles were used, then the supersonic turbojet could not fly faster than Mach 1.4, and even takeoff would be marginal.



CUTAWAY VIEW of model of possible Mach 4 turbojet engine shows three-stage compressor and small combustor chambers, which result in a highly compact powerplant.

One proposed aircraft configuration calls for installing the Mach 4 engines in under-wing pods pressed closely against the fuselage. This geometry is said to minimize interference effects.

It was admitted that the basic turbojet engine is capable of yielding more than enough thrust to propel a craft at Mach 4. This thrust should be about 35% more than the thrust required. However, design problems at lower speeds would keep the craft below Mach 1.4 unless some ingenious steps were taken.

Studies show that a Mach 4 turbojet would have very little pressure rise across either its compressor or its combustion chamber. Thus, NACA conceives of the engine with only a three-stage compressor instead of the 12- to 15-stage compressors used in today's engines. In addition, satisfactory combustion can be obtained with much smaller combustor sections than in present-day jet engines. Thus, a smaller compressor plus smaller primary and afterburner combustion chambers contribute to compactness.

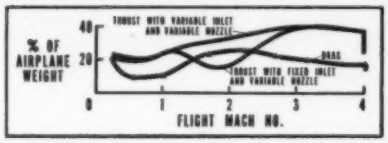
Above Mach 3, the rotating parts in the engine do little or negative work. Here, the afterburner is the thrust-generating element. At Mach 4, then, the turbojet engine approximates a ramjet engine. Above Mach 4, the pure ramjet engine has the field to itself insofar as air-breathing powerplants are concerned.

NACA engineers are confident that the proposed powerplant can be built. They say that if the engine is operated at its designed speed, it will have a thermal efficiency of about 42%. This compares with the 28% efficiency of a Mach 2 engine, and the 33% efficiency characteristic of steam-electric stations.

The efficiency is the result of an extremely high pressure in the engine cycle. The expansion ratio, based upon internal and ambient pressures, is over 100.

The Mach 4 turbojet engine derives its greatest advantages from its variable inlets. As an example, a fixed inlet at Mach 2 would give a drag-thrust ratio of 0.61, because of the spillage pattern. If a variable inlet were used at the same Mach number, the drag-thrust ratio would be cut almost in half, to 0.31.

Similarly, a fixed Mach 4 exhaust nozzle would be woefully deficient at Mach 1 because of over-expansion of the exhaust gases. Here, the efficiency would be about 70% as compared with the 97% efficiency for a variable exhaust nozzle.



AIRPLANE DRAG characteristics call for variable inlet and exhaust nozzles to achieve speeds over Mach 1.4.

Although the aerodynamic combustion principles are being satisfactorily worked out, severe practical problems exist because of the high temperature in which the engine components must operate. The inlet temperature is pegged at 1,240°F, which rises to a temperature between 3,500°F and 4,000°F in the afterburner. This temperature rise is smaller than in present jet engines. However, temperature of the compressor is so high that it will need alloys currently being used in turbine blades.

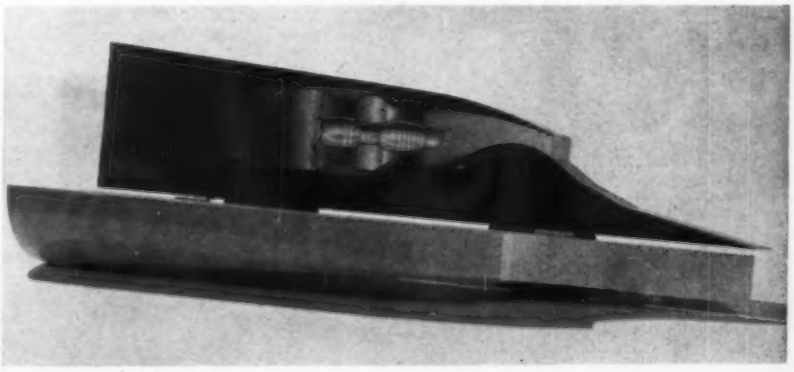
Development of engine bearings and seals comprise other design problems that must be met by the fabricators of this engine, according to NACA.

AiResearch uses F-101B fuselage in altitude tests

A McDonnell F-101B interceptor, without engines, wing and tail assembly, is being used for simulated combat missions in AiResearch's altitude chamber at Phoenix, Ariz.

As check-out tests for AiResearch-built heating and refrigeration system, the cabin section and its black boxes are undergoing 180 eight-hour shifts at altitudes to 50,000 ft. and temperatures from "blistering" to −65°F.

The project, if successful, will achieve three purposes: reduction of equipment lead-time; better instrument record of "flight" tests for better aircraft performance; ground tests can be conducted at fraction of cost of airborne tests.



TYPICAL ENGINE POD is slung under wing and next to fuselage. Note large exhaust nozzle needed for Mach 4 operation. Air inlet ramp is at right.

Westinghouse metal miracles boost jet engine performance 15%

Turbojet "hot end" parts, made from clad molybdenum, are increasing jet engine efficiency up to 15% by permitting higher turbojet operating temperatures. Developed by Westinghouse research scientists, this new method of coating molybdenum to prevent high-temperature oxidation has proved successful during extended engine testing of "clad-moly" parts at temperatures above 2000°F.

Development of this protective coating—which remains intact and effective after molybdenum alloy sheets or shapes are formed into parts of complex shapes—is part of the advanced metals research program at Westinghouse. The Aviation Gas Turbine Division is helping to keep America strong by applying this coating and other new research developments to create better and better jet engines for the defense of America.

Take advantage of Westinghouse's ability to engineer, develop and produce equipment for America's defense. Contact your Westinghouse Defense Products sales engineer, or write: Westinghouse Electric Corporation, Aviation Gas Turbine Division, P. O. Box 288, Kansas City, Missouri.

J-91057

The first stage turbine nozzle vanes (outlined in red) were chosen for initial testing as they are subjected to the highest temperatures and are most susceptible to thermal shock.

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DIGEST

Industry faces new stretchouts, financial headaches as result of Administration's spending ceiling

A RADICAL monthly payment limitation, threat of new stretchouts and slippages and a 30% reduction in the fiscal 1958 aircraft shopping list faced industry as the Air Force struggled to bring its spending within the White House and Defense ceiling.

At presstime, Air Materiel Command was evaluating contractor estimates of expected monthly payments on each active contract of $5 million or more. Preliminary estimates earlier in the month were found to be substantially greater than the overall ceilings assigned to each company by AMC.

With reduced payments, possibly throughout all of fiscal 1958, industry is faced with providing its own financing or else asking for downward delivery adjustments. Promise of some relief in spring, when new taxes are in the Treasury, is held out as solace, but it makes the industry economic future "less worse," not better.

Airframe manufacturers, with Air Force prodding, were moving rapidly toward new layoffs, reductions in inventory and curtailment of capital equipment and material procurement. Pentagon officials have pleaded for maximum overhead reductions before contractors request program adjustments.

But even with such emergency measures, Air Force officials acknowledge that further stretchouts and slippages will be necessary along with some cuts in new procurement. Fighter and "lesser" missile programs will be the first victims with the immunity of the big bomber and tanker programs lessened. The latter is dependent on Boeing Airplane Co.'s success in reducing cost and obtaining outside financing.

Any private financing will seriously jeopardize industry profits. The government cannot legally reimburse its contractors for interest paid on loans. Of further and deeper concern is the availability of bank financing with all major manufacturers trying to float long term loans at one time.

Air Force Under Secretary Malcolm MacIntyre was hopeful that need for company financing would be for a short term only, just to "tide industry over," with loans paid out of projected later payments toward the end of the year. More permanent credit measures would be required only if total payments are short of costs over a much longer period. He was optimistic that the overall Defense spending picture would loosen up in the spring as predicted.

While he defended industry against recent criticism by Defense officials, MacIntyre stressed the urgency of reducing costs immediately. The debt ceiling, he explained, just will not permit the more gradual leveling off that would be more desirable. Everyone has to move faster to reduce overhead, inventories and cut down labor. Readjustment might have come later, he acknowledged, but added "it had to come—either sooner or later."

In the wake of the new belt-tightening, Boeing announced another 5% personnel layoff, Republic an additional 2,500-3,000 employes and other force reductions in other companies will follow rapidly. Boeing also revealed it was urging subcontractors to assume a greater load of in-work inventory and slowing down the equipment of its new $100-million plant expansion program.

Trend of industry and Air Force actions belied the parting words of Defense Secretary Wilson. Charging a brushoff, industry was incensed over what it felt was a glossing-over of the facts. Wilson felt industry was just being "stampeded" and that the monthly payment restrictions were "not as radical as it might seem on first review."

Acknowledging the possible need for further stretchouts, the outgoing Defense chief quipped that all industry may have to do is "reduce their buying of materials a little bit and run a little more economically or they may have to lay off a few people."

Great savings, he felt, could come out of what he had "always considered excess inventories and the shortened lead times."

In a parting shot, before new Defense Secretary McElroy took over, Wilson added to industry woes by indicating that, on top of the monthly payment blow, further reductions in progress payments may come later.

Under Secretary MacIntyre told AMERICAN AVIATION that the new Air Force restriction was made necessary because other economies would not be felt before the end of fiscal 1958. Crux of the monthly payment estimates is to determine how much procurement programs were underpriced, he said. If not underpriced, Air Force must determine if spending has been faster than planned because of reduced lead times.

The evaluation will determine this and next year's procurement programs. MacIntyre noted that procurement is now the only area the Air Force has not brought under spending control. The contract-by-contract estimates will be worked into the new program and submitted to Defense. Defense then will make fiscal 1958 apportionment.

Air Force planners had a fiscal 1958 program firmed up by mid-September but the new crisis may change its complexion somewhat. However, it is hoped that the monthly payment ceilings can be worked out along with stretchouts of earlier programs. But at presstime, here's how the aircraft and missile program looked:

Original 1958 shopping list of 1,515 airplanes was pared down to approximately 950 aircraft, based on an expected new obligation ceiling of about $6 billion for all procurement of aircraft, missiles and related equipment.

There was no change in the bomber programs as presented to Con-

F-102A spits rocket fire

SALVO of 24 2.75 in. folding-fin aircraft rockets leaves firing tubes in the missile bay doors of Convair's F-102A Delta Dart. About .2 sec. later the full blast of the rockets' exhaust blends into mass of flame. Coat of gray enamel protects plane from blast, small metal scoops deflect exhaust debris from aircraft.

gress. Boeing would receive anticipated contracts for 101 B-52s plus a large KC-135 tanker award based on the production ratio of two tankers to three bombers. Success of the Convair B-58 test program has kept the 18 supersonic bombers on the shopping list for a total of 31 evaluation aircraft.

Only three of the Century series were scheduled for support: McDonnell F-101B, Convair F-106 and Republic F-105. Air Force expects both the McDonnell and Convair aircraft to be introduced into ADC at about the same date. The Convair F-106, scheduled to replace the interim Lockheed F-104 in ADC, had slipped because of some technical difficulties. The F-104 day fighter will be phased into the Tactical Air Command as deliveries of the F-106 are stepped up.

Lockheed C-130 is the only transport scheduled for fiscal 1958 procurement, with about 95 on the list. The Douglas C-133 is stretched and will hold at a one-a-month production rate through the year.

Northrop will receive an order for six of its T-38 supersonic trainers for USAF evaluation. Change in Air Training Command plans forced a cutback in the Cessna T-37 primary jet trainer production. The build-up was slowed down to a 17-a-month schedule for the same quantity on order—delaying the date of the final delivery.

Air Force is ready to go on Thor IRBM as soon as a decision is made. Boeing Bomarc is the second large program, followed by the Northrop Snark.

Jet engines on the procurement schedule are the General Electric J79, and Pratt & Whitney J57 and J75. Continued support of both the GE J85 and Fairchild J83 is still planned, although a decision between one or the other may have to be made this fall.

AMC has already negotiated a large number of new fiscal 1958 contracts which can be immediately finalized when Defense releases the apportionments. Conscious that it is well into the second quarter of fiscal 1958 without a new order signed, AMC has crossed its fingers that the new spending reduction go-round will not cause too many changes in negotiated procurements. At best, it is estimated that new contracts will not be signed until early November.

But financial pressure on the industry was not to be applied solely by the airmen. Navy, on the heels of the Air Force's bad news, notified about nine of its aircraft and engine contractors that it too may have to defer some monthly payments.

Bureau of Aeronautics, in private discussions with the nine manufacturers, outlined a similar but less drastic plan. It anticipates that some payments may be held up through the end of calendar year 1957, or about three months. It estimates that about 25% of inventory billings may be effected, with the deficit made up in the last two quarters of fiscal 1958.

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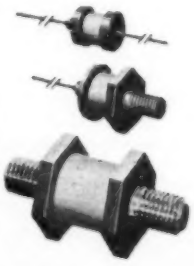

This series, ranging in voltage ratings from 50 to 400 volts peak inverse and current ratings from 500 milliamperes to 15 amperes, is completely hermetically sealed to meet military requirements. Both axial lead and stud mounted types are available.

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Launching of satellite by Russians forces Administration to take new look at missile and satellite programs

The Soviet Union's launching of the world's first earth satellite early this month has touched off a major Administration reappraisal of U.S. ballistic missile and satellite programs.

The Soviet feat also sparked a rash of Congressional demands for a sweeping investigation of U.S. progress in the critical weapons area, and at least one Senate group was ordered to make a preliminary study of the problem. This was the Preparedness Subcommittee of the Senate Armed Services Committee.

At least one definite result of the Russian "Sputnik" will be increased emphasis upon more ambitious satellite and space exploration projects looking beyond the current U.S. Vanguard program. Among these are the Air Force's unmanned military reconnaissance satellite, known as "Big Brother," as well as proposals for unmanned vehicles to explore the moon and even the nearer planets of the solar system.

More difficult to assess is the impact which the Soviet satellite may have upon the U.S. ICBM/IRBM development program. Work on these big weapons has been proceeding at a rapid clip and it is questionable whether they would profit from a big new injection of funds. Furthermore, despite charges by Administration critics, there has been little evidence that these critical programs have suffered—so far—from the cutbacks in military expenditures.

In broader terms, it is clear that the Administration can learn a considerable lesson from the resounding success of the Soviet satellite.

Size of the Sputnik indicates beyond doubt that the Russians drew upon their ballistic missile program for at least the first-stage propulsion unit necessary to start the satellite upon its orbital journey. This can only mean that Russia has a definite edge on this country in ballistic development.

Russia has forged into a considerable lead over the U.S. in the exploration of space. It has demonstrated a capability for hurling instrumented objects nine times the weight of the Vanguard satellite into a stable orbit, and it has declared that additional launchings are planned in the very near future.

The Soviet Union regards its satellite program as a tool for the accomplishment of definite political and long-term military objectives, as well as immediate scientific objectives. Judging from the worldwide propaganda success of the Soviet Sputnik, the U.S. can no longer afford to regard it as simply a device for gathering information from the upper atmosphere and the fringes of space, but must follow the Soviet line.

As of last week, the implications of the Soviet success had not been fully absorbed in all quarters of the government concerned with U.S. satellite activity. But President Eisenhower was scheduled to meet with the Scientific Advisory Committee on Tuesday to discuss the missile and satellite program, and it appears likely that this and similar meetings will ultimately produce a far more vigorous U.S. assault upon space.

Meantime, the 184-pound Soviet satellite continued to whip around the earth every 96 minutes on an orbit tilted 65 degrees with respect to the equator. Its orbit appeared to be an ellipse, with an apogee (point of greatest distance from the earth's surface) of about 560 miles, and a perigee (point of closest approach) of 125 to 150 miles.

The Sputnik initially broadcast intermittent signals on the 20- and 40-megacycle frequencies, but these changed to steady signals, possibly as the result of meteor damage to the equipment. There was also speculation that the vehicle was telemetering special data to the Russians on unknown frequencies.

Scientists here and abroad were in disagreement on the probable life of the satellite, with some inclined to believe it will stay aloft for a year or more. But whatever time is remaining for it, it is clear that the little moon has served the Russians extremely well, and that it will probably be of profund influence on this nation's long-term program for exploration of space.

'Big Brother' old news to AMERICAN AVIATION *readers*

Published reports last week concerning Air Force's so-called Big Brother Project for development of a photo-reconnaissance earth satellite came as no news to readers of AMERICAN AVIATION.

A detailed description of the project, with illustrations, was published in this magazine July 2, 1956, (pp. 36, 37, 38). The article, entitled "AF Tackles Vast Problems of Recon Satellite," was written by Erik Bergaust, then Missiles Science Editor of AMERICAN AVIATION and now Executive Editor of *Missiles and Rockets* magazine.

Manned aircraft still best deterrent, says Gen. Cook

Launching of the Russian satellite does not change "our conviction that there is no 'ultimate' weapon; that our powerful manned air force is our chief deterrent to aggression and will remain so for many years to come," according to Orval R. Cook, president of the Aircraft Industries Assn.

Cook remarked that the importance of guided missiles is based on a variety of types for a variety of missions.

"On this point, President Eisenhower told his press conference Wednesday (Oct. 9) that manned aircraft will be needed for many years to come. Today, our military planners tell us that, in the aggregate, we are still ahead. We believe that to be true. How we *stay* ahead in total air power is our foremost problem," he said.

Sputnik's Sting

The launching of the satellite Sputnik by the Soviet Union was not only a great scientific achievement, but one of the great events in the history of the world.

But it carried with it a terrific sting to the U.S. with all of its much-vaunted technical achievements. It was essentially a psychological and political licking, since no one doubts the ability (in due course, at any rate) of the U.S. to reach its goals in outer space. (But Sputnik *was* first, wasn't it?)

The lesson to the U.S. has been long overdue. Too much aggressive, boastful speech-making. Not enough action. A concentrated crash program could have succeeded long before this had the top civilian and military brass realized the importance of being first in the thinking of hundreds of millions of people over the world whose minds are the targets of two ideologies. It was not money that was needed most. It was unified direction and a dedication toward a single goal.

Congress will conduct all manner of investigations but these will do nothing more than produce scapegoats and confuse the basic issue. The real need is leadership from the White House, the kind of leadership which will match the single-minded crash programs of the Soviet Union. AMERICAN AVIATION's companion magazine, *Missiles & Rockets*, has long since warned of Soviet progress, and even predicted the satellite launching was not far off. It's time for the U.S. to go to work in earnest.

Wayne W. Parrish

Boeing leads defense producers for 6 1/2 years

Boeing Airplane Co. is the top defense producer in the United States both over the 6½-year period beginning July 1, 1950 and for the two years between January 1, 1955 and December 31, 1956. Tabulation of the relative positions of major aircraft, missile and related equipment producers during the two terms follows (in millions of dollars).

		Jan. 1, 1956—Dec. 31, 1956		July 1, 1950—Dec. 31, 1956
Rank	Company	Contracts	Rank	Contracts
1.	Boeing Airplane Co.	$1,914.4	1	$7,074.0
2.	General Dynamics Corp.	1,758.2	7	4,493.4
3.	North American	1,699.5	6	4,539.6
4.	United Aircraft Corp.	1,686.1	3	5,563.6
5.	General Electric Co.	1,289.8	4	5,024.1
6.	Lockheed Aircraft Corp.	1,181.4	8	4,076.7
7.	American Tel. & Tel. Co.	1,015.3	9	2,773.0
8.	Ford Motor Co.	866.8	11	2,477.3
9.	Douglas Aircraft Co., Inc.	858.7	5	4,559.1
10.	McDonnell Aircraft Corp.	688.6	18	1,381.2
11.	Hughes Aircraft Corp.	681.9	23	920.7
12.	Curtiss-Wright Corp.	643.2	10	2,583.7
13.	The Martin Co.	622.9	15	1,542.7
14.	International Bus. Mach.	450.6	24	837.2
15.	Chance Vought Aircraft Co.	411.4	51 *	381.3
16.	General Motors Corp.	385.8	2	7,024.8
17.	Bendix Aviation Corp.	371.1	16	1,518.9
19.	Raytheon Mfg. Corp.	313.2	31	687.4
20.	Radio Corporation of Amer.	307.6	21	1,060.0
21.	Sperry-Rand Corp.	306.5	14	1,584.6
22.	Republic Aviation Corp.	275.2	12	2,406.5
24.	Avco Mfg. Corp.	215.9	28	738.2
25.	Northrop Aircraft, Inc.	213.4	20	1,167.4

(No. 18 in short period was Standard Oil Co.; 23 was Westinghouse Electric Corp.)
** Chance Vought became independent of United Aircraft on July 1, 1955.*

Thor, Jupiter tests to be stepped up

The second successful launching of the Thor IRBM missile from Cape Canaveral, Fla., was made following an announcement that tests on both the Air Force Thor and Army Jupiter would be stepped up.

Defense Secretary Neil McElroy confirmed that both programs would be continued through testing stages before a selection is made. Less than one-tenth of the test missiles for both programs have been fired to date.

FEIA wins Western election

Western Air Lines' flight engineers elected Flight Engineers International Assn. as their bargaining agent, replacing Airline Flight Engineers Assn. FEIA received 69 votes, ALFEA 8, and ALPA 8.

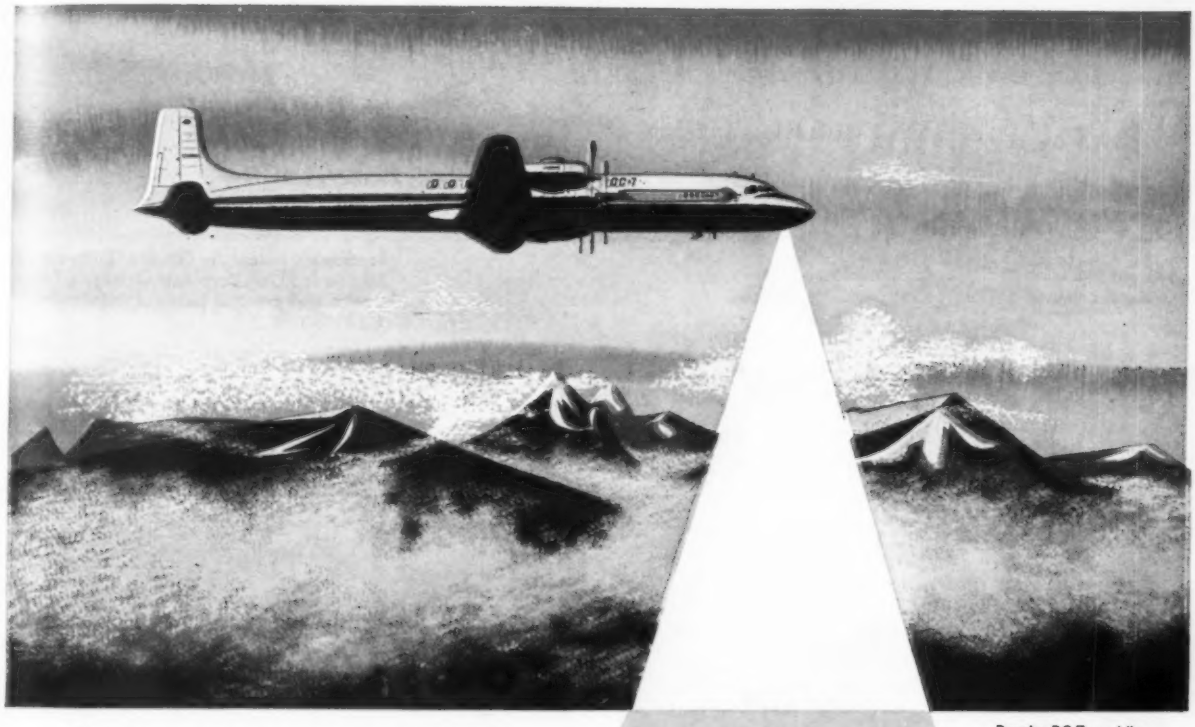
NWA to build overhaul base

Northwest Airlines signed a lease agreement with Minneapolis-St. Paul Metropolitan Airports Commission for an $18-million overhaul base to be built for the airline at Wold-Chamberlain Field.

Hercules demonstrates tanker capability

LOCKHEED C-130 troop-cargo carrier shows another facet of its ability as it refuels jet fighter planes during Marine-Navy tests at Patuxent River, Md. Portable refueling equipment wing pods and two 500-gal. tanks in cargo compartment, can be installed or removed rapidly. F3H-2N and F11F fighters above received their fuel at 25,000 ft. from the turboprop tanker.

B.M.E.P. Gauges Prove AC RELIABILITY



Douglas DC-7, world's fastest airliner, uses AC-285 Platinum Spark Plugs.

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Today's man-about-the-world heads for gay South America

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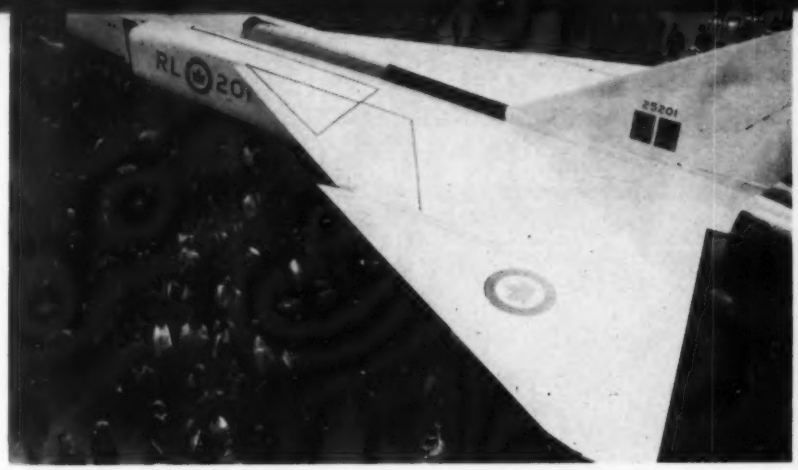
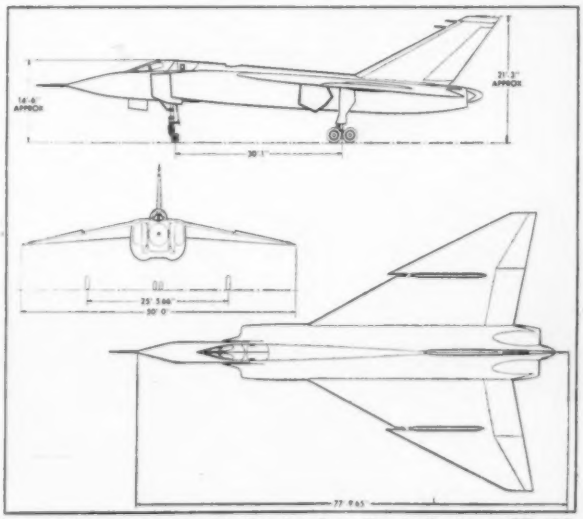


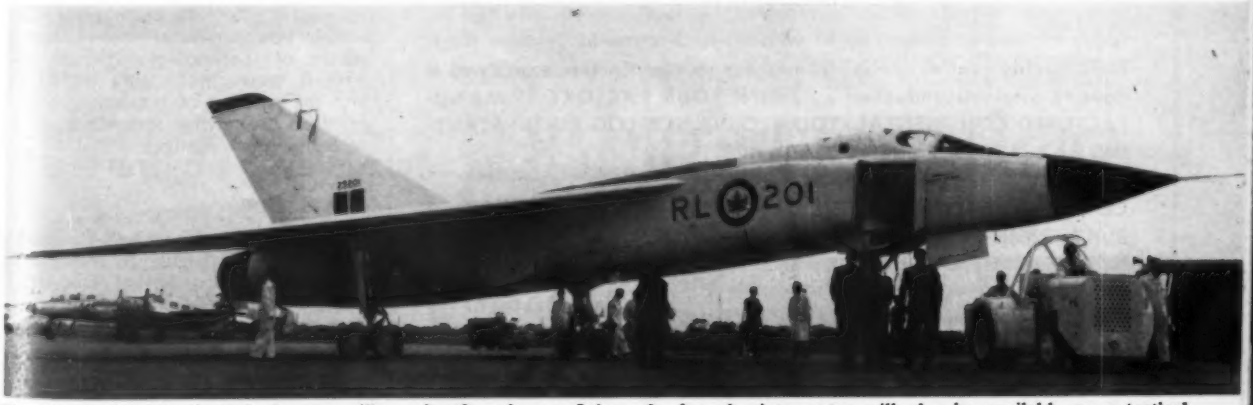
The large size of the Avro CF-104 Arrow, rolled out in Toronto at the beginning of the month, is clearly shown in this photo. The design bears some resemblance to the delta aircraft built by Britain's A. V. Roe Ltd., which like Avro Aircraft, is a member of the Hawker-Siddeley group.

Canada rolls out largest interceptor, the Avro Arrow

The curious bifurcated intake of the Avro Arrow is apparent in this photo. Radar nose is part of an electronics system developed by RCA and Minneapolis-Honeywell, known as Astra 1. It is used for automatic flight, weapon fire control, communication and navigation.



Largest interceptor ever built, the Canadian-built Avro CF-105 Arrow 1, grosses about 34 tons. Dimensions of the twin-engine aircraft are shown in this three-view. Note slots in leading edge of the wing which is probably designed to counter pitch-up. Prototype has two J75s; production versions get the Orenda Iroquois.



The Arrow in this photo looks more like a bomber than a fighter. In fact the interceptor will also be available as a tactical bomber and in a photoreconnaissance version. Much of the test work was done by NACA and Cornell Aeronautical Labs.

Suit against Beech dismissed by court

A suit against Beech Aircraft Corp. charging "utter, gross, shocking failure to warn" a pilot of the dangers of flying his Beech Bonanza was dismissed by Judge Richard S. Rodney of U. S. District Court, Wilmington, Del.

Beech had counter-charged that the pilot was at fault in an accident because of "his own negligence in venturing into blind-flying weather when he had no instrument or blind-flying rating."

The suit was filed on behalf of the estate of Nathan Prashker, who was killed October 5, 1953, after taking off from Allegheny County Airport, Pa. Plaintiff's attorney, Lee S. Kreindler, indicated that he would appeal.

Allison gets contract for new turboprop engine

Allison Div. of General Motors Corp. has received an $8-million contract for development of the Model 550 turboprop engine. The engine is understood to be a twin-spool powerplant of substantially greater power than the 3,750-hp T56. Power is estimated to be about 5,000 hp.

Allison began work on the new engine about three years ago for the next series of turboprop transports. The company supported the project with its own funds and the new contract represents the first major government support for the engine.

Armour develops new aerial thermometer

Development of a thermometer device that will help aircraft increase range and save fuel has been announced by the Air Research & Development Command. The "vortex thermometer" will give pilots direct, true free-air temperature readings accurate to ±1°F while traveling at high speeds.

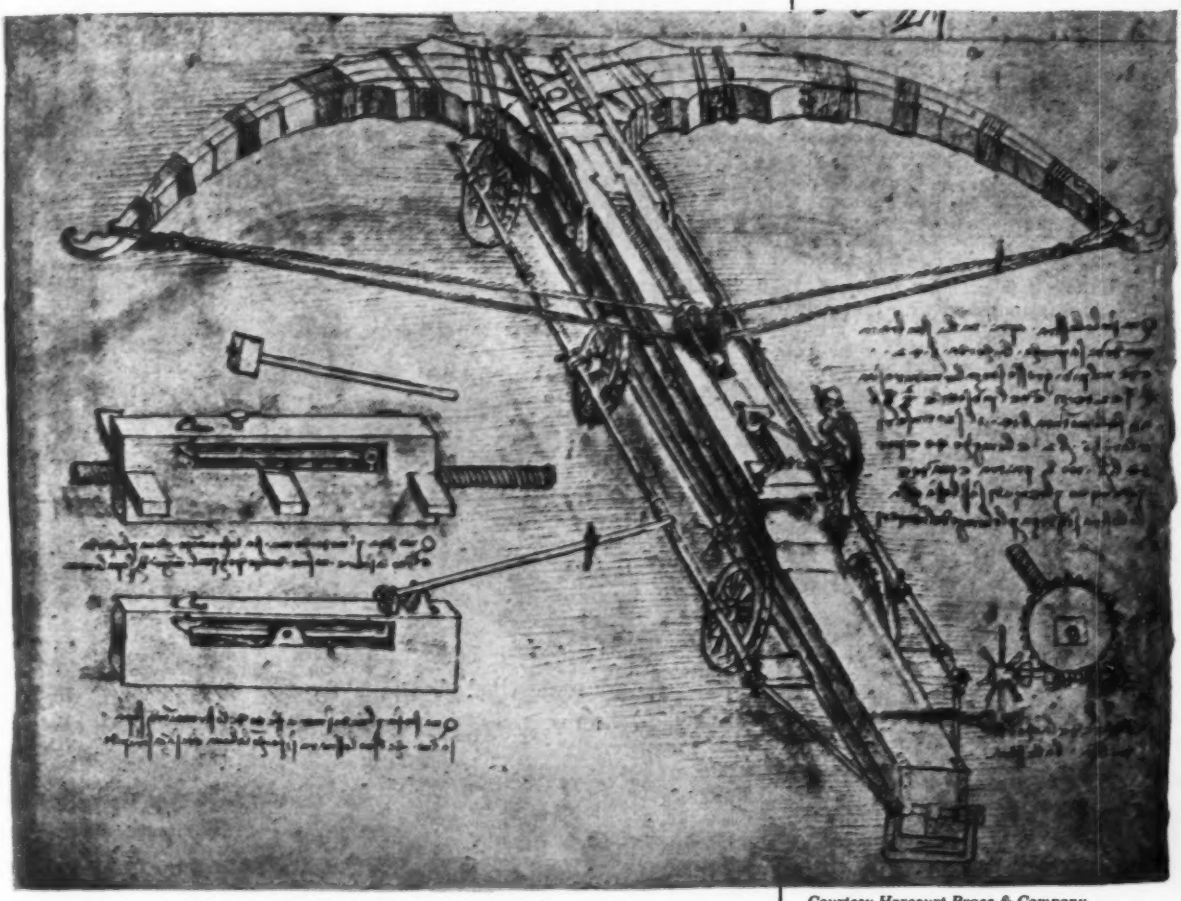
The device was developed under contract with ARDC's Wright Air Development Center by Armour Research Foundation of the Illinois Institute of Technology. It can assist aircraft crews in locating jet streams and the position of maximum velocity in them by giving immediate ranges of temperature changes.

Correction

AMERICAN AVIATION's Honor Roll column in the August 26 issue (p. 51) incorrectly reported that Chester G. Miller, public relations and advertising manager for Pastushin Industries, Inc., Los Angeles, had completed 30 years service in the industry. The name should have been that of Victor Pastushin, president and founder of the company.

"...engines of wonderful efficacy not now in use."

Thus wrote Leonardo da Vinci in 1481 of his crossbow on wheels, certainly a fore-runner of the guided missile, in a letter to his friend, Lodovico Sforza, seeking employment as a military engineer.



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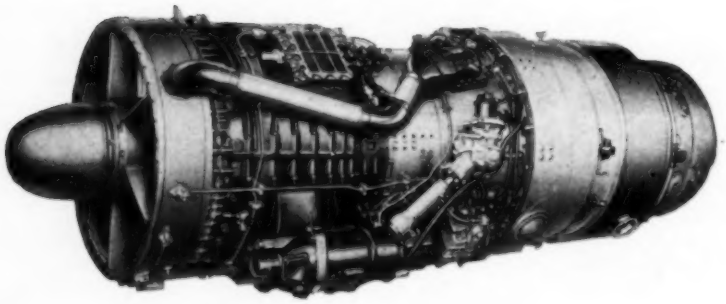

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Manufacturers' interest in business aircraft rises, but emphasis is still on military orders

by George Shaw

There was a marked change in the aircraft industry's attitude toward the business aircraft field at the National Business Aircraft Assn. meeting in Denver.

Economy waves and cutbacks in military procurement in recent months have resulted in a rash of speculative feelers on the part of industry. But a number of company officials told AMERICAN AVIATION that the "shrinking" military market hasn't shrunk to the point yet where a major swingover is being considered.

One company spokesman interpreted the trend thus: "Certainly there is a fresh and vital (civilian) market opening up and we're interested, but military orders are still money in the hand. Often that military interest in a new model can fill the gap between the drawing board and the production line."

There seems to be a growing conviction that the parallel development of aircraft for both civil and military use will continue. Actually cutbacks in some areas of military purchasing have accelerated service requirements for the same types of aircraft used by business.

Army and Air Force off-the-shelf utility plane programs are stimulating the market for executive-type aircraft. Both services are accumulating large fleets on the four- to seven-place light twins.

But, by the same token, military interest in a plane such as the new Lockheed Jetstar can keep that model off the business aircraft market for as long as two years. Turboprop aircraft in the high-performance executive/business class are under study by industry and operators and a few models are already here, but in too many cases it still takes a military order for the model to accomplish the all-important tooling-up.

It appears that the trend is toward a "buyers market" in the utility aircraft field, both civil and military.

Considerable interest at the NBAA meeting was shown in inexpensive and lightweight communications and navaid equipment tailored to the light twins. It is generally conceded the light twin for some time will constitute the mass market for suppliers of airplanes and components.

There was considerable feeling at the sessions that high-speed jet and turboprop executive planes will be less in demand than was hoped. Most optimistic estimate was that possibly 300 of the high-priced aircraft would be absorbed by business aviation.

A more realistic analysis indicates a market of about 100 of the million-dollar models.

On Mark Engineering's President Robert O. Denny told the assembled members his company was going ahead with the Model 450 Marksman in the firm belief that the market was there. Denny said that there were two orders on the books for the 400 mph-plus Model 450, one from Maytag and the other from Phillips Petroleum.

The Marksman is called by the company "expensive but economical" at $1,180,000; plus about $150,000 for communications and navaid equipment, and between $35,000 and $40,000 for customizing. It is equipped with two Allison 501D-13/15 turboprop engines and has a maximum range of 3,100 miles.

Beech displayed its new Model 95 Travel Air and a plush mockup of the Super 18. A Beech representative pointed out that there is a growing interest in the Super 18 because of its speed and comfort and the fact that it is in the "attractive" price bracket of high performance medium twins.

The Cessna 310B and Model 620 were on exhibit—the 620 in mockup only. The company didn't feel there was anything to gain by taking the production 620 away from Wichita while it is undergoing testing for CAA certification. Cessna seems to have in the 620 the ideal next-step-up for the light and medium twin operator, with a price tag under $300,000.

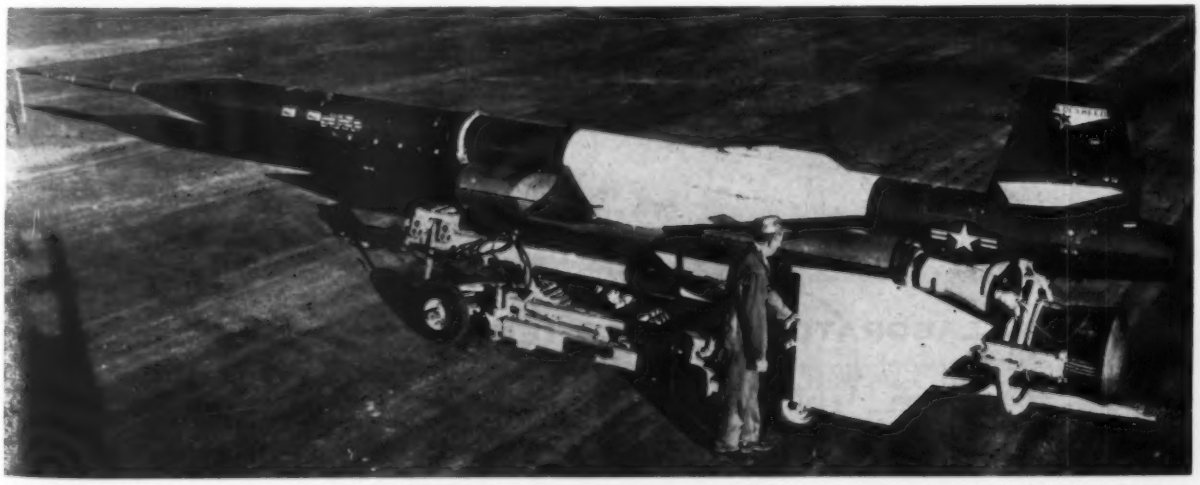
With four Continental GSO 526A, 340-hp engines the 620 is pressurized for over-the-weather flight and has design cruise speed of about 250 mph. A gas turbine compressor in the rear cone of the fuselage provides heating, air conditioning, pressurization, forced ventilation and dc power for engine starting and all ground requirements.

Perhaps the most unusual exhibit was the ACME Triphibian, featuring turbofan engines and boundary layer control. Chief engineer on the Triphib, R. M. Berns, said the plane had a span of 40 mph landing speed to 400 mph top speed, adding that there was quite a bit of military interest in the design. The seamless hull of the V-tail flying boat is of structural sled design, employing magnesium and fiberglas.

William T. Piper, Sr., presented a complete line of present production Piper aircraft, including the recently unveiled Comanche. Comanche is a single-engined four-placer checked on its first cross-country flight at 160 mph IAS. Reported selling price will be $13,900.

Trekker's Royal Gull Amphibian was floated in a pool in the Mile-High

Lockheed ramjet target tests missiles



SUPERSONIC Q-5 ramjet target missile is being developed to test accuracy and destructive power of nation's defensive weapons. Instrumented to score theoretical hits, Q-5 is recoverable by parachute. Vehicle is 39 ft. long, has wingspan of 10 ft., weighs more than 7,600 lbs., is 20 in. in diameter.

Center. Visitors could see how the plane looks in its natural element, a lake or stream, and could get aboard for a look over the bow.

New chairman of the Airways Modernization Board, Lt. Gen. Elwood R. (Pete) Quesada, addressed the banquet that closed the convention. He told the group that the AMB had the money, the personnel and the assignment to do something "right now" about the critical Airways problem, and he said that they would not be deterred by red tape or anything else in getting the job under way.

Quesada told NBAA that he would call on its membership for a great deal of assistance, and, "with your help I can do a good job—with your opposition I wouldn't be able to do it at all."

Kindelberger hopes for more stable conditions

North American Aviation, Inc., has hopes for stabilizing sales and employment after adjustment to changing conditions taking place in government procurement in the next few months, NAA Board Chairman J. H. Kindelberger and president J. L. Atwood told the company's Management Club.

"This period of transition is the most confused I've seen in 40 years in this industry," Kindelberger said. He pointed out that the company suffered a 30% employment reduction through cancellation of the Navaho program and stretchouts in the F-100 program and other projects which failed to materialize.

Present employment in NAA Divisions and total projected for the next year break down as follows:

Los Angeles—21,000 with estimated reduction to 13,200 as F-100 program tapers off.

Missile Development—presently 2,750; expected reduction to 1,750.

Autonetics—presently 5,700; expected increase to 6,300.

Rocketdyne—presently 10,000; expected increase to 10,800.

Atomics International—presently 1,550; expected increase to 1,725.

Columbus—presently 13,500; estimated reduction to 9,500 as F-100 phases out. Future employment may be bolstered by FJ-4 and FJ-4B business and projects for the T2J and A3J now under development.

USAF to spend $1.3 billion for electronics in 1958

Air Force funds for electronics will go from about $750 million in 1957 to about $1.3 billion in 1958, according to Brig. Gen. Ben. I. Funk, deputy director for ballistic missiles for USAF.

Most of the money will go toward ballistic missiles, he said. The Air Force already has spent some $175 million for guidance, and this amount will increase to $600 million next year, Funk said.

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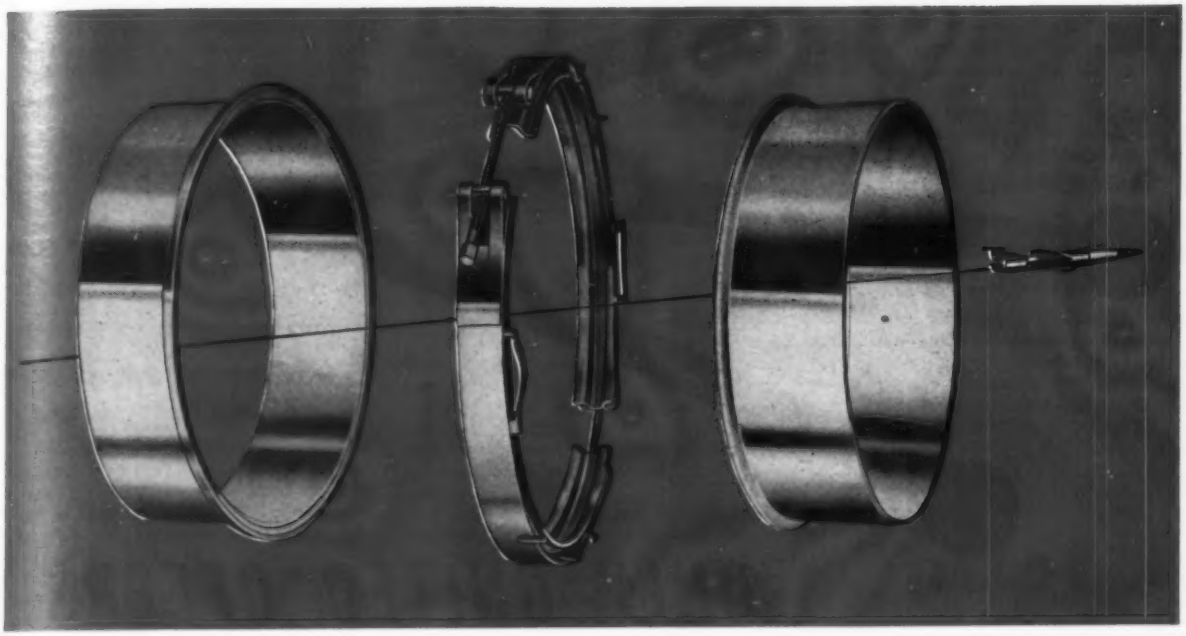

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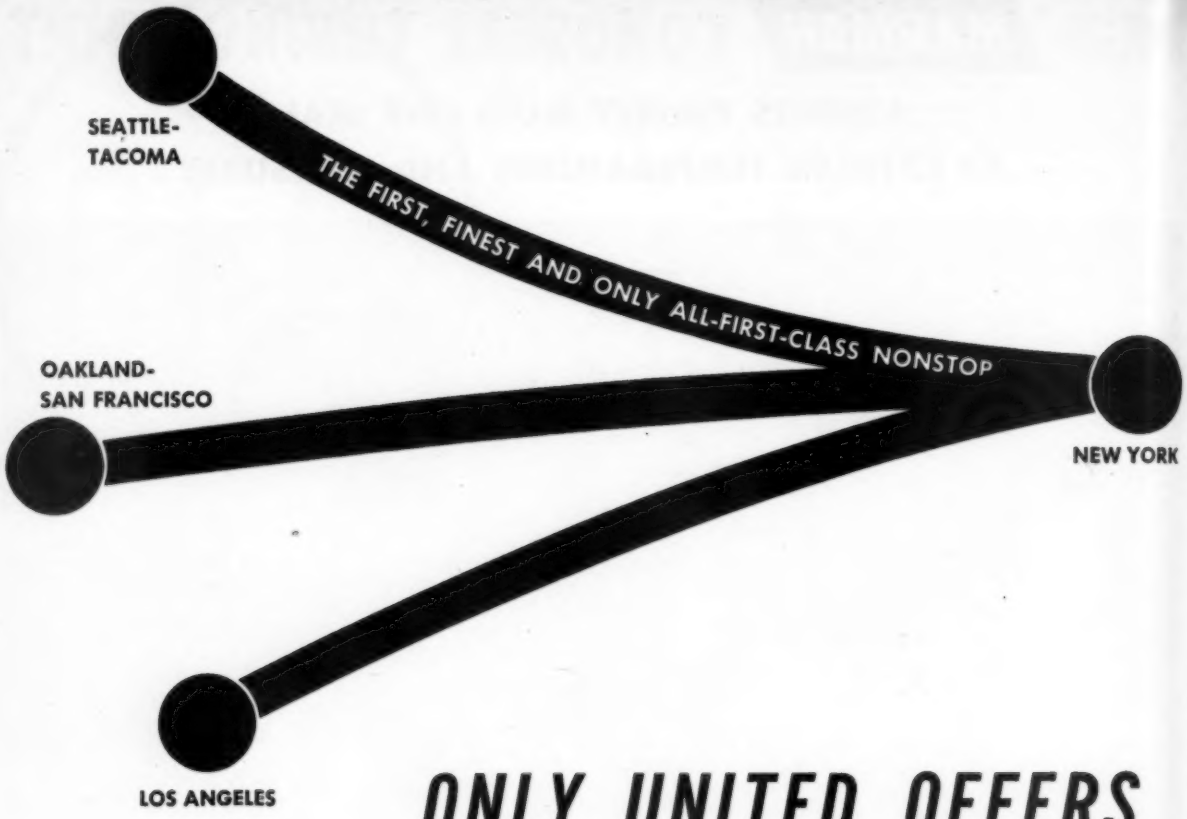

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House subcommittee to investigate CAB; agency accused of being 'uncooperative' in producing files

A House subcommittee headed by Rep. Morgan Moulder (D-Mo.) and supported by the biggest budget of any similar Congressional group ($250,000) has made the Civil Aeronautics Board the initial target of a general investigation of Federal regulatory agencies.

Although the House group, officially designated the Subcommittee on Legislative Oversight, is in the preliminary phases of its probe, it had ordered early public hearings on allegations that CAB was uncooperative in the production of files for Subcommittee investigators.

All five CAB Members were directed to appear at the hearings. CAB says it has never been as liberal in making files available as with the Moulder group. Unofficially, Board spokesmen estimate about 98% of the Board's files are open to inspection. But the line has been drawn on personal files of Board Members, files related to cases still in progress, and private communications between the Board and the President and other Government offices.

Indications were that other regulatory agencies were equally hesitant to open up all their files. Thus, the public hearing on CAB could be in the nature of a test case. Meanwhile, the subcommittee's early timetable calls for full public hearings on matters generated by its investigation sometime next spring.

Pyle, Durfee to speak at new terminal opening

Week-long dedication ceremonies this week will mark the opening of the new $12,500,000 terminal area at Love Field in Dallas. Official dedication will take place on Thursday with CAA Administrator James Pyle making the principal address, following the Airline Presidents' luncheon, to be addressed by CAB Chairman James Durfee.

Airlines will move into the new building next week, with full operation getting under way on November 1. The completed terminal construction is part of a $25-million construction program at the Dallas airport.

Other developments include: $6,500,000 operations base for Braniff Airways; $1 million hangar for Delta Airlines; $1,300,000 operations hangar for American Airlines; and a $4 million base for Southwest Airmotive, Inc. American, Braniff, Continental and Delta have financed a $1 million underground fueling system.

National fights shutdown on two fronts

National Airlines, inoperative since September 22, was doing battle on two fronts at presstime. It was engaged in the labor dispute with the Air Line Agents Assn. which led to the shutdown and in a separate effort at CAB attempting to ward off applications of other airlines to fly its routes.

News in connection with the labor dispute was all negative. National Mediation Board withdrew from the dispute and left the parties to work out a solution between them. First effort failed and National, in a document filed with CAB, accused the union of "repudiating" a verbal agreement.

At CAB, Pan American, Panagra, Northeast, and U.S. Overseas Airlines filed various applications to fill the gap created by NAL's absence from the east coast market. But only Mackey Airlines came up with a CAB authorization and it was limited to Miami-Key West segment of NAL's routes.

Only about 300 of NAL's 3,500 employes remain on the payroll during the shutdown. Traffic at this time of year normally averages 5,000 passengers per day, indicating a traffic loss of about 105,000 passengers during the first three weeks of the strike.

Pan American's traffic in West Germany booming

Pan Am is doing a land-office business on its numerous routes between West German cities and Tempelhof Airdrome in West Berlin. With 21 flights per day, PAA carried over 70,000 passengers in September, a new high mark, 37,600 of whom were outbound from Berlin.

High-density DC-4s are used with trips running between an hour and ten minutes to an hour and a half each way. Only other carriers are BEA and Air France, since Berlin operations are restricted to Allied powers.

TWA launches de luxe first-class service

Trans World Airlines inaugurated a new de luxe first-class service on October 14, over the protests of American Airlines and United Air Lines. Complainants urged CAB to make the service proposal subject to Board tariff filing requirements, thus exposing it to a possible CAB suspension action.

The TWA proposal affects Lockheed 1649A aircraft used for seven daily nonstop transcontinental flights. It involves the substitution of 32 sleeper seats in the first-class compartment for the 44 standard seats normally used. No change is involved in the 20-seat coach compartment of the aircraft.

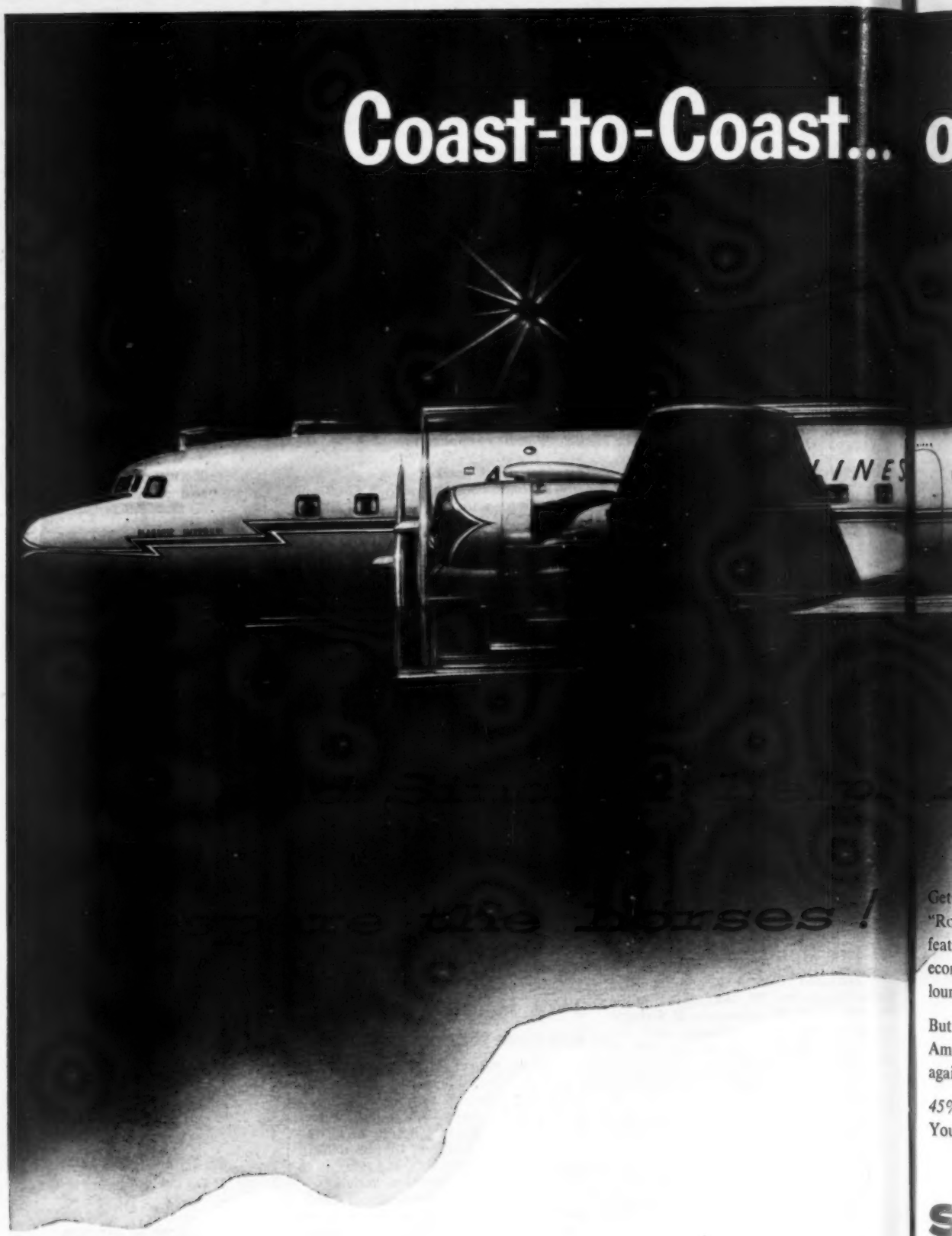
Slump in traffic hits domestic airlines

Domestic airlines have been hit by an unexpected slump in traffic, which started about mid-September. Airline officials state that the defense cutbacks and general business conditions are definitely contributing factors. Cutbacks have particularly hit airline business on the west coast.

Some carriers are now lagging behind their forecasts, although they are still ahead of the same 1956 period. A few are said to be below last year's level.

CAB refuses to suspend new higher cargo rates

Civil Aeronautics Board this month refused to suspend increased specific commodity cargo rates proposed by 14 domestic airlines. New rates, reflecting an average 10% increase, became effective October 13.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BRIEFS

Manufacturing—military

Northrop Aircraft has received a total of $20 million in contracts from Raytheon Manufacturing Co. for development and manufacture of Hawk missile airframe components. Contracts cover facilities, engineering services and procurement.

Navy will sell four Martin Mars flying boats in mid-December on a sealed bid basis. Navy Supply Center at Oakland, Calif., is acting as disposal agent. Planes are at Alameda Naval Air Station for inspection.

Grumman Aircraft Engineering Corp. has put a price tag of $700,000 on its Dart-powered Gulfstream twin-turboprop transport. Price is exclusive of furnishings, electronic, radio and other custom interior equipment to be installed by Grumman distributors.

Convair has announced receipt of orders for seven Metropolitan 440s from three foreign airlines. Garuda Indonesian Airways, Ansett Transport Industries, Ltd., and Karhumaki Airways are the customers.

Boeing Airplane Co. has begun initial shakedown tests of its $300,000 sound suppressor-thrust reverser test facility at Renton, Wash. Facility has two engine ground run-up silencers measuring 45 ft. by 12 ft. in diameter.

Navy has canceled the weapon system requirement for the HCH cargo unloader helicopter under development by McDonnell Aircraft Corp. Navy will continue support for the large rotor system for possible future applications.

Air Materiel Command has awarded Aero-Test Equipment Co., Inc., Dallas, a contract totaling $1,369,650 for construction and installation of altitude and compression test chambers.

North American Aviation, Inc., has established Navan Products, Inc., as a wholly-owned subsidiary. Headquarters will be at Santa Monica. Firm will be a marketing and licensing organization handling specialized products developed by NAA.

Beech Aircraft Corp. has delivered the first remanufactured L-23D to the Army under a $1.7 million modernization contract. Modification to "D" configuration makes planes equivalent to 1957 models, for which Beech has a $2.8-million contract.

Strategic Air Command will deactivate its 91st Strategic Reconnaissance wing at Lockbourne Air Force Base, Ohio, about November 8. Tight money is said to have forced the elimination of the RB-47 unit.

The Garrett Corp. has announced the resignation of W. C. Whitehead, president and Murray S. Gelber, vice president and manager of the company's AiResearch Mfg. Co. of Arizona. J. C. Garrett has been elected president. He is also board chairman and chief executive officer. K. B. Wolfe has been named executive vice president. Jack O'Brien succeeds Gelber at Phoenix.

Boeing Airplane Co. has reduced overhead personnel by 5% in both Seattle and Wichita areas. Layoff notices were issued in response to Air Force economy requests.

Pan American World Airways has ordered 53 airborne Loran units from Edo Corp. for installation in its fleet of jet transports. Order calls for 21 units for DC-8s, 17 for Boeing 321s and 15 sets as spares.

Aeronutronic Systems, Inc., Ford Motor Co.'s west coast subsidiary, will acquire a 200-acre site near Newport Beach in Southern California. Company will build over a period of years a multi-million dollar research and development center.

Financial

Avco Manufacturing Corp. has announced consolidated net earnings and special credit for the nine months ended Aug. 31 of $8,586,374, equal to 92¢ a share. A dividend of 10¢ a share was announced, payable Nov. 20 to stockholders of record Oct. 29.

Beech Aircraft Corp. directors have declared a quarterly dividend of 30¢ per share on its 823,352 common shares outstanding payable October 20 to stockholders of record October 18. Sales for the fiscal year ended September 30 amounted to about $35.5 million.

The Garrett Corp.'s sales for the fiscal year ended June 30 reached a total of $176,095,038 compared with $138,981,762 last year. Profit was up to $4,940,582 from $4,807,504 last year.

The Flying Tiger Line reports net income and special items totaling $101,669 (equal to 5¢ a share) for the fiscal year ended June 30 compared with $2,975,771 for the year before. Gross revenues were $24,651,146, up 12% over the previous year.

Transport

Frontier Airlines applied to CAB for $2,648,724 temporary mail pay, an annual increase of $154,068 over present rates, through Sept. 30, 1958. Company also asked for a $3,757,716 permanent rate for the same period. Higher pay is needed because of "inflationary forces and rapid increases in operating costs," FAL said.

Northeast Airlines gave up the lease on its C-46 Curtiss Commuter, the first such plane to be used by a U.S. scheduled airline for passenger operations. The plane, which has been out of service for six weeks, is being returned to L. B. Smith, Miami, from whom it was leased with option to buy. The option will not be exercised. NEA is now using Convair 240s on Boston-Montreal flights formerly operated with the C-46.

Pan American World Airways has acquired 25,000 shares of capital stock of Philippine Air Lines. This represents a 4.17% interest in the 600,000 shares of PAL stock issued and outstanding, PAA told the CAB. Investment value of the PAA purchase is about $125,000.

TWA on Sept. 30 completed its first nonstop polar flight from Los Angeles to London. The Lockheed 1649A Jetstream made the flight in 18 hrs. 32 mins.

RCAF names Canadair CL-28 'Argus'

ACCEPTANCE of first CL-28 by Canadian government and christening of the submarine-killer aircraft as "Argus" was witnessed by a crowd of some 9,000 at Canadair's Montreal facility. Aircraft are to be used by RCAF's Maritime Air Command. Other nations reportedly are interested in the patrol aircraft.

PEOPLE


MILLER


PATTERSON


SCHNEIDER


MUHLEISEN


THUE


POMMERY

Manufacturing

Name	New Position	Former Position
Donald M. Miller	Exec. vp, Airborne Instruments Laboratory	VP Engrg. and Production Div.
Everett M. Patterson	Pres., Bulova Research and Development Laboratories, Inc.	VP-research and engrg., Standard-Thomson Corp.
Stanley S. Schneider	Dir., engrg., govt. and industrial divs., The Magnavox Co.	Mgr. Switch Gear Production Div., Canadian Westinghouse Co.
Edward H. Muhleisen	Mgr. aircraft and missile industry, Fischer & Porter Co.	Dist. mgr. Wilmington, Del., office
Horace W. Thue	Dir. mfg. planning, International Business Machines Corp.	Mgr. missile and commercial aircraft div., Douglas Aircraft Co.
George C. Keefer	Dir. contract admin., Canadair Ltd.	Mgr. purchasing dept.
Ben L. Ettelson	Project mgr., Atlas ICBM, American Machine & Foundry Co.	
Peter King	Gen. mgr., Crop Culture (Aerial) Ltd. and Britten-Norman Ltd.	Dir. customer service, Turbo Div.
John M. Carter	Pres. California Tech. Industries Div., Textron Inc.	Pub. rel., Bristol Aeroplane Co.
Donald F. Kehn	Account mgr., Allison Div., General Motors	VP and gen. mgr.
Lester A. Wells	Exec. vp, Thiebolt Aircraft Co., a div. of Vitro Corp. of America	With Kudner Agency, Inc.
J. Forrest Bigelow	Mgr. radar and radio systems, Philco Corp.	Pres. and gen. mgr., Engrg. & Research Corp.
Robert G. Clark	VP and treas. Epsco Inc.	Assigned to transistors and color TV
William A. Drews	Head, electronic group, Electromechanical Div., Atlantic Research Corp.	With Empire Trust Co. of N.Y.
A. S. Chivers	VP, Western Div., Barry Controls Inc.	Ft. Detrick (Md.) Biological Warfare Lab.
John T. Gorham	Mgr., Industrial Security Dept., Bell Aircraft Corp.	Gen. mgr.
Henry X. Ross	Chief, development engrg., Aeronca Mfg. Corp.	With U.S. Secret Service
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Dr. Burton F. Miller	VP, The Ramo-Wooldridge Corp.	Asso. Dir., Guided Missile Research Div.
Milton E. Mohr	VP, The Ramo-Wooldridge Corp.	Dir., Communications Div.
W. T. Noll	Mgr., production, personnel and procurement, Aeronautical Div., Minneapolis-Honeywell Regulator Co.	Group dir., Control Systems and Boston divisions
C. L. Davis	Mgr., sales, planning and research, Aeronautical Div., Minneapolis-Honeywell Regulator Co.	Dir. of production
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Charles H. Churchill	Exec. vp and gen. mgr., Pacific Polymers	Sr. project engr., Packard Bell Electronics
Francis T. Greenup	Chief product engr., Consolidated Electrodynamics Corp.	Gen. mgr.
Ralph Lehman	Mgr. aircraft instrument sales, Western Electrical Instrument Corp.	Asst. chief product engr.
William R. Keye	Asso. dir. engrg., Control Data Corp.	Sales mgr., with Federal Telephone and Radio
A. T. Burton	Pres. Navan Products, Inc., subsidiary of North American Aviation	Dir. product design, Remington Rand Univac
Bernard B. Daien	Chief engr., Transistor Devices, Inc.	VP North American Aviation
Dana Bollar	VP-sales, Rotor Craft Corp.	In research and development
John Bender	Sales mgr. and vp, Humphrey, Inc.	Sales mgr., Grand Central Aircraft Co.
Ralph J. Leppla	Supv., static regulator and control design, Leland Electric Co.	Vice president
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Herbert P. Fields	Mfg. mgr., Hupp Aviation Co.'s Chicago plant	Gen. foreman
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Ralph S. Maugham	Dir., passenger conference and interline activities, American Airlines	Dir. intercarrier passenger sales
Santos Ceyanes	Asst. operations mgr., Pan American	Mgr. Miami overhaul base
Robert F. Moore	Mgr. Miami overhaul base, Pan American	Atlantic Div. maintenance mgr., New York
P. J. B. Wimbush	Retires Jan. 1, 1958	Gen. mgr., Central African Airways Corp.
Mrs. Anne Carlin	Sales rep. in chg. commercial accts., Northeast Airlines	With Varig and Aerovias Brasil
James T. Scholtz	Asst. vp-operations, Miami, Panagra	Regional mgr., South America, Lima, Peru
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LEONARD EISERER,
(Signature of business manager)

Sworn to and subscribed before me this 11th day of October, 1957.

HELEN M. DES PREZ,
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(My commission expires November 30, 1961)

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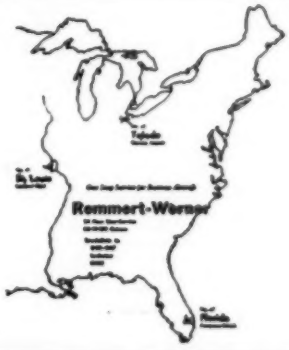

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EN ROUTE

by Wayne W. Parrish

W.W. P. no candidate for guest of honor at carving party

THE AIRPLANE is a pretty tricky thing. In an awfully short space of time you can get whisked out of civilization and plopped down into places you didn't know still existed. Such as cannibalism and the stone age.

I can still see those tough-looking natives sizing me up as an awfully nice well-fed plump specimen suitable for carving up at a festive occasion. Medium rare.

As they say on TV, this was a real live show. In color, too.

It was down in New Guinea last March when Orm Denny and Jack Stammer were flying me around the tropical mountains to show off some isolated airstrips. We were in a single-engined de Havilland Beaver operated by Qantas Empire Airways and had flown over some mighty rough country when we came into a sizable deep valley and set down on an airstrip that had a hump in the middle so you couldn't see the other end when you landed or took off. (That Beaver can land anywhere!)

Denny told me he wanted me to see some real back country but I wasn't quite prepared for what I found.

The place was called Menyamya and consisted of several mission houses and a government house and the airstrip. There was no road connection of any kind. An Aussie patrol had packed in to lay out the airstrip and then a Beaver had made 57 flights to bring in the building material and all equipment for the government station. An Avro Anson had brought in the mission houses, board by board, and the establishment was being supplied by the Qantas Beaver service and by a Cessna 170 operated by the mission people.

It was really good and isolated, entirely air-supported. No road anywhere near.

Curious is word for Pappy

Well, old Pappy Parrish in his store-bought clothes (nothing like my regular business suit for these quickie National Geographic expeditions!) hopped out of the Beaver to see what this was all about. Several score natives gathered to watch the arrival and at first I thought they were just like natives I've seen many other places. But after some closer looks I took quick double-takes. These folks were mighty strange-looking creatures. They didn't look like anything I'd ever seen before. They just didn't seem to warm up as old friends and acquaintances. In short they looked pretty tough.

Up to greet us came the Aussie in charge, a friendly bloke in a military tropical outfit, and we walked down to the government house. I began asking some questions about how things were in these parts.

Well, he says, things were reasonably quiet around the post right now. The station was established several years ago to try to eliminate organized warfare and then had succeeded as far as the immediate area was concerned.

Of course, he says, these people have awfully sharp and quick tempers and ever so often one of them hacks an old pal to pieces, following an old Chicago and New York custom, but he was proud to report that there hadn't been *organized* warfare for awhile.

What did he mean, says I, by *organized* warfare?

So he explained that for centuries in these mountains one group or tribe will sit around plotting to do away with a neighboring tribe or group and then they proceed with plans and this little hassle is followed by a feast, usually with a chief as entree.

You mean cannibalism, I asked? Exactly. Lots of it not far from here but none around the station any more, he hoped. Well, says I, wondering if our Beaver had enough gas to get out of the valley, how far away do you mean? So he pointed down the valley and says right down there, four or five miles away, that's stone age country and organized warfare and cannibalism are still in progress. All live, no film.

Stone-age stuff

Every week or so a delegation from down the valley comes up, he says, to tell him and the mission people to get out or be pushed out, but so far the warriors haven't been able to make good on the threats. And he allowed as how the white man would hold out, but admitted the station had to be alert at all times.

I figured this was no place for me.

Just down that valley from where we landed the natives are still using stone axes and weapons. A steel hatchet or axe is a very prized asset. As any Chicago delinquent knows, a steel blade isn't nearly as messy as a stone axe if you want to to chop off somebody's head, but steel is still in short supply fortunately for all concerned. The natives have no firearms and wouldn't know how to use them (but the Commies doubtless will establish a supply line and helpful training school in due course).

I was willing to be reasonably sympathetic to the native viewpoint on eating one's dear departed if those who were standing nearby would only stop looking at me as though I was being sized up for a pot roast. After all, when you think about it, what greater mark of respect could you show the departed after hacking him to pieces than to roast the remains on a nice fire. Knock off enough in one battle and you've got a week's supply. (The New York custom of shoving the remains down a sewer is not only crude but wasteful.)

For myself, I'd insist on *trés bien cuit*. (To you peasants, that's very well done, in French.) If I'm going to eat somebody's thigh, I insist on it being broiled properly. I have never really cared much for rare meat.

New Guinea customs

Here are some other tid-bits I picked up:

Shells are currency. The mountain natives plunder the coastal areas with constant raids to get more shells. Even the Aussies and mission people use shells for trading with natives for fruits and vegetables. A shell necklace is a sign of wealth.

A typical costume for men is a sheath of grass over his front, downwind that is, tied around in the back, and a strip of bark cloth hanging down the behind like a window shade. If he really rates he has a cape of bark cloth and some strands of shells for decoration.

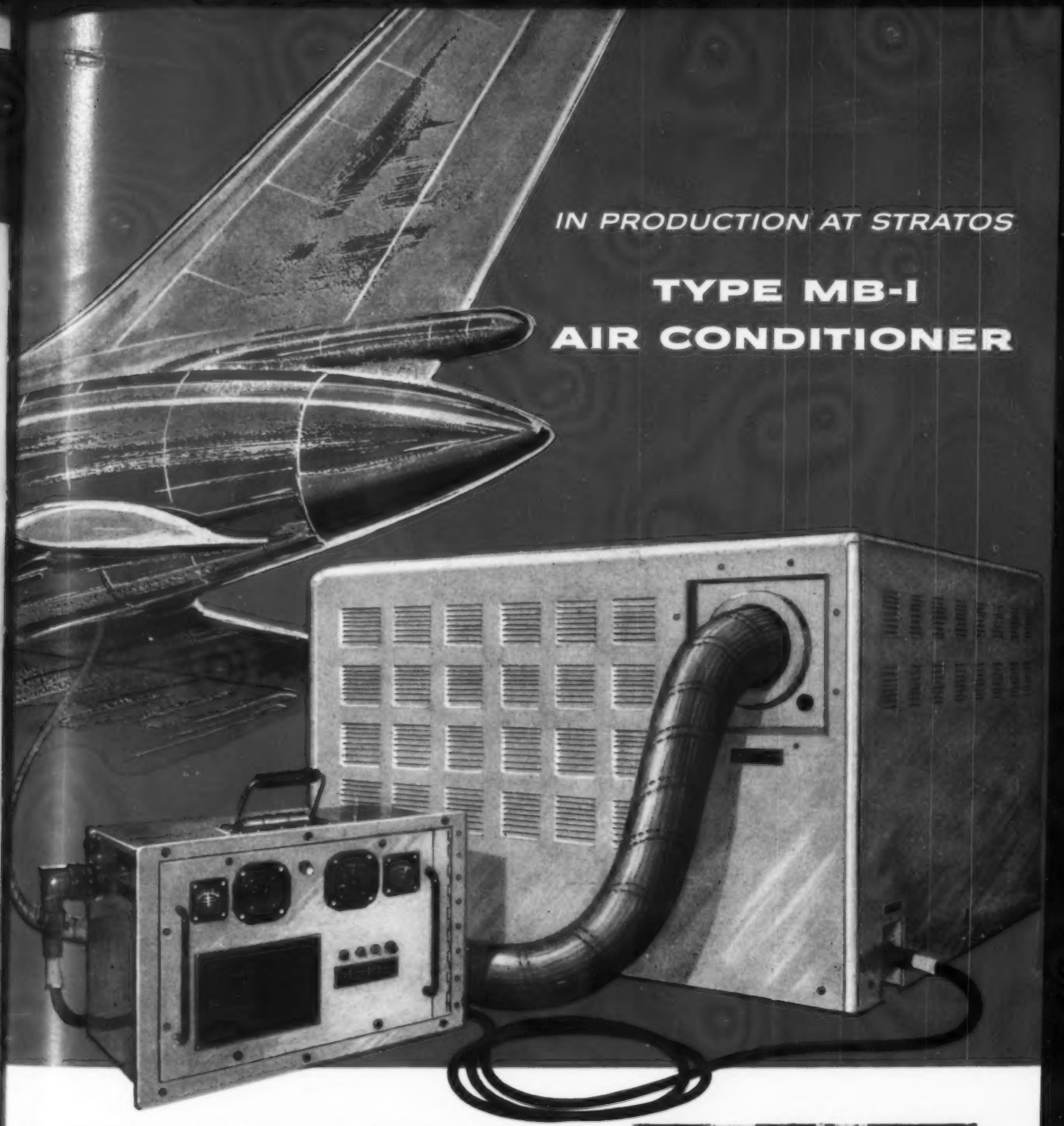
A chief wears over his loin the thigh bones of the cassowary bird, a relative of the emu, which is the largest bird on earth except for the ostrich.

The mission had succeeded in putting prim gingham dresses on most of the women and girls who live near the station.

The hair-dos for men and women were out of this world. Frizzled, that is. Several women carried home-made cigarets in holes bored in their ears. Some of the men had bones through their noses. They were a tough-looking lot.

Here in this isolated New Guinea valley were natives just barely emerging from the stone age. If the white man moved out, they would revert promptly to their primitive ways—and to cannibalism. But slow, steady progress is being made to bring these people into the world of the 20th century. It was a strangely moving experience for me to dip, for just an hour, into an age that has existed virtually unchanged for thousands of years, back to the time when all men had only stones and bark and other crude essentials for existence, and considered his fellow man a prime ribs delicacy, properly charcoal-broiled, of course.

Might be a good idea before trying to conquer the outer spaces around the earth to finish up the job of exploring and developing what we've got here on the ground.



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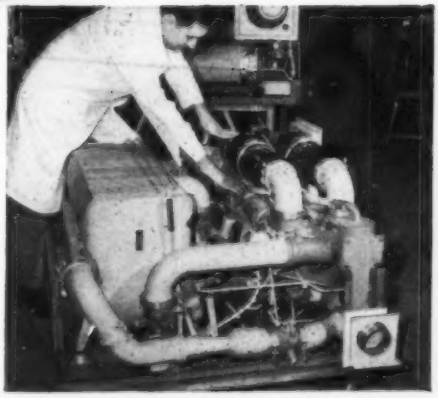

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